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Heavy Milling Machines.

We give herewith engravings of a horizontal and of a vertical spindle milling machine, designed especially for heavy work, and built of any width, hight, or length desired. In the case of the particular machines illustrated, the one with the vertical spindles will handle work 36 inches wide, 36 inches high, and 12 feet long; the other machine will take work of the same width and length, 24 inches high.

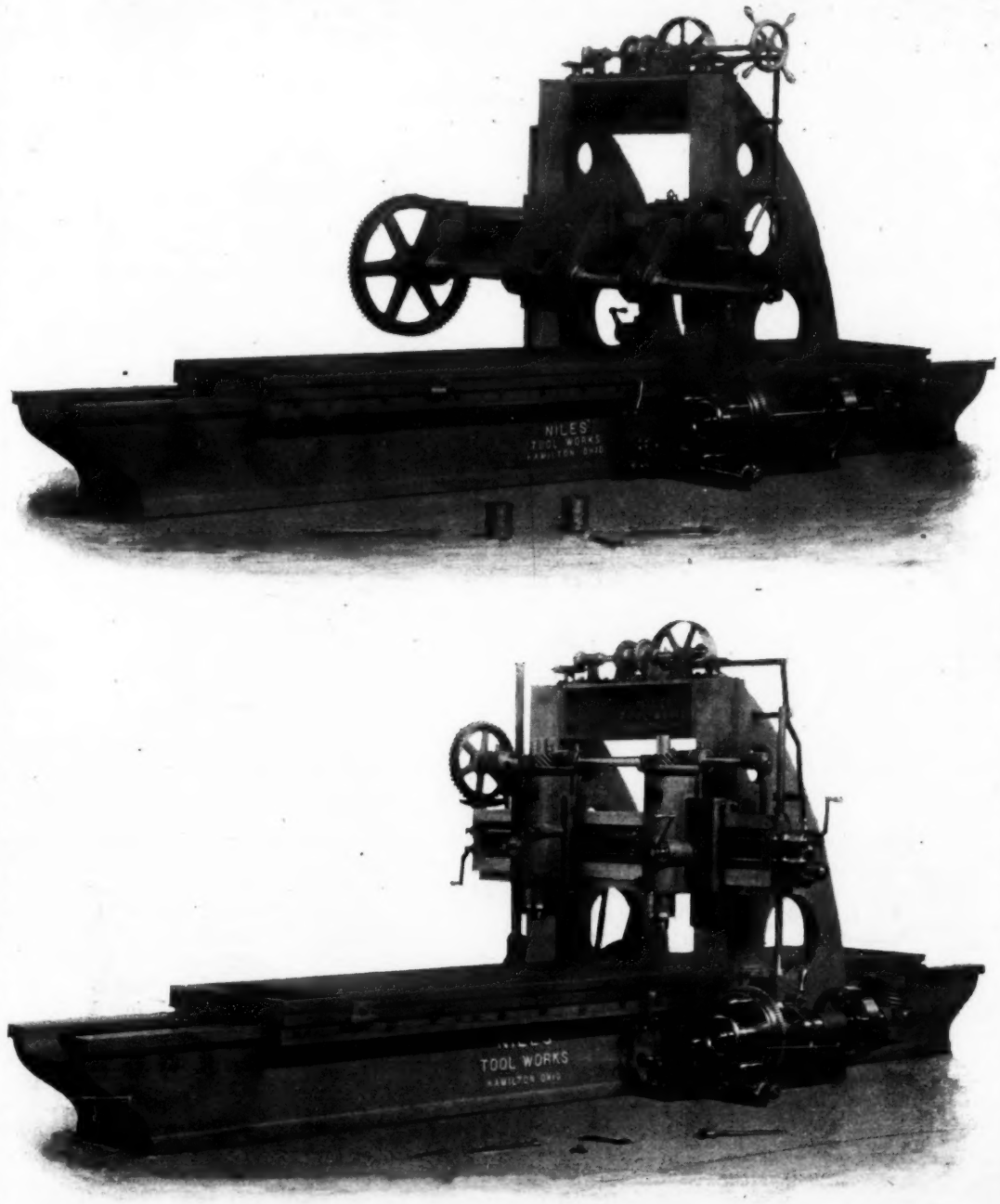
Recognizing the fact that present practice in milling calls for heavy cuts in many cases, these machines have been designed to secure great strength and rigidity. The housings are double-webbed, and the cross rail is of box section. The bed is extra long to prevent excessive overhang of the platen, which moves upon flat surfaces to which it is gibbed outside as shown, the outer guiding surfaces being square. Water channels are provided for taking care of lubricant that may be used during the cutting. The platen is driven by helical gearing, and is arranged for throwing out the feed automatically at any point. The platen can also be moved quickly by independent countershaft for adjustment in either direction. The power feed can also be thrown out, and the platen operated by hand.

In the vertical machine the cross feed to the saddles is thrown out either by hand or automatically, as may be desired. They are also provided with quick hand adjustment, both cross and vertical, and the two spindles are driven by helical gears.

The cross rail in both machines is raised and lowered by power, and in the horizontal machine is provided with hand movement for close adjustment. The cross feed of the spindles is reversible by slip gears at the end of the rail.

Though these machines are quite new and have been in use but a short time, it has been demonstrated that on work to which they are adapted, three to four times as much can be done on them as was previously done upon planers.

The machines are built by the Niles Tool Works, Hamilton, Ohio.



HEAVY MILLING MACHINES.

Various Kinds of Slide Valves.

BY CHARLES A. HAGUE.

In these days of automatic engines, the plain slide valve, with a set closure, lead, and compression, is not very much in evidence in power plants of any considerable size. It is true that the locomotive is still found, all things considered, most manageable and efficient with its peculiar environment, with the slide valve; but even here the adjustments of the link motion produce effects that go far towards the toleration of the slide valve, aside from the valve's own merits as a simple steam distributor in a field where simplicity, strength and reliability are paramount. In single-valve automatic stationary engines, the modifications into balanced and double-ported valves very nearly rob the original factor of all recognizable features.

However, notwithstanding the predominance of other forms of steam gear, a very large use is still made of the D-slide valve, and where it is used many varieties may be found, from the good specimens down through all grades of viciousness; the valve in its best shape being the product of the intelligent use of the steam-engine indicator, and the bad ones the haphazard results of guessing in the dark. Through long practice and observation, stationary and marine engineers, who have had under their charge all sorts of engines, have been known to acquire an instinctive perception of what to do in experimenting for betterment, or at least to perceive in which direction improvement was to be sought, and such men with an indicator at their command could, no doubt, bring out all points it was practicable to secure; indeed there are many examples of this practice of making the best of what was started wrong, in the line of slide valves.

A slide valve, when properly designed and proportioned, and driven by an eccentric in the usual way, should admit the steam promptly, freely and fully, up to the pressure determined by the regulating or governor valve, permit the steam line to be made with the least practicable amount of wire drawing under the conditions, cut off the steam at about three-quarters of the stroke, afford an early and free exhaust, obviate to the utmost possible extent all counter-pressure, and, finally, close the exhaust port at a point in the stroke that will give a reasonable amount of compression. When doing all this for both ends of a steam cylinder, the slide valve, a single item of the engine, is a wonderful specimen of simplicity and effectiveness, probably not surpassed in the importance and complication of its functions by any known single piece of mechanism.

But although it is simplicity itself, as consisting of only one piece of metal sliding back and forth over the steam ports, the proportioning of the slide valve so as to properly accomplish the purposes for which it is designed, might well be considered within the realms of complication, as far as the mental evolution connected with its production is concerned, and as is often attested by the failure of this simple member of an engine to properly distribute the steam.

The system of admission, cut-off, and release, at the present time considered to be the best and most effective, all things considered, especially for powers of magnitude, was, no doubt, suggested to the mind of its inventor by the idea of cutting the slide valve into four portions, each working edge of the valve detailed to perform a special service. Some bright minds have since devised specialties in details, in the manner and in the times in which these four edges should work in relation to each other; but the steam lap, the exhaust lead, the moment of induction, the instant of compression, were all attributes of the slide valve before the automatic cut-off was thought of. With the single-valve automatic engines, which have come to the front in force within the past seven years or so, it looks as though the variation in the compression curve had as much to do with the regulation of speed as the variety in the cut-off, and it further looks as though the variable compression was an "incident" not altogether anticipated in the original purpose, the steam and exhaust lead also varying somewhat. In fact, the single-valve automatic handles its slide valve just about as the locomotive link motion does, and varies the indicator diagram a good deal in the same manner. It is interesting to look back along the line of development, or rather to go back to the starting point and look forward. The different functions were all provided for in the old original single slide valve, but progressive minds began to perceive that the limits of expansion had been reached, and that the details must be rearranged and their relations changed; then followed the subdivision of the valve. As the benefits of a variable automatic expansion to suit the load became firmly established through the course of twenty years or so, the desire to carry the economy into smaller engines became apparent, and an automatic cut-off upon the back of the slide valve was resorted to, with an eccentric adjustable by the governor. Then the reaction took place all the way back to a single slide valve, and with an eccentric also adjustable by the governor for regulation of the point of cut-off. The objection to the line of refinement, embodied in the operation of the induction, and the exhaust valves, separately in the four-valve engine, is largely commercial; the objection reinforced by the desire to avoid complication, although in some cases

each of the four working edges of what was formerly the slide valve, is controlled by an independently adjustable motion.

But to return to the plain slide valve; an illustration of a very fair distribution of steam by a single slide valve is shown by Figs. 1, 2 and 3, drawn to different scales for convenience sake, but exhibiting the various angles of the eccentric, and different points in the stroke affected. Fig. 1 shows a valve in central position with ¾ inch steam lap at each end, and with the exhaust edges of the valve "line and line" with the inner edges of the steam ports. Fig. 2 indicates the motion diagram, showing the relative positions of the eccentric, the crank pin and the piston; the angularity of the connecting and eccentric rods being disregarded, as such deviations can be accounted for nearly enough in practice with little trouble.

In Fig. 2 the letter *X* shows the crank pin center, and *S* the center of the eccentric movement. From this it will be observed that with a valve as shown in Fig. 1, the eccentric will be advanced to the line *C D*, when the crank pin is in the line *A B*, the valve just ready to open and admit steam to the cylinder when the crank passes the center. The cut-off by the lap of the valve takes place when the eccentric has reached *E D*, and the crank pin has arrived at *F G;* the piston having traveled 20 inches out of the 24 inches of the stroke, is shown at *H J*.

tion; not from its central position, but from one extreme to the other.

It does not pay to go too far in cutting off steam with a single slide valve, as the stroke and spread of the valve involves additional power to drive it, to say nothing of the distortion of steam ports, increased length of steam chest, and addition to the item of waste room or clearance. The object of cutting off steam is to secure economy, and after the possibilities of one valve driven by a set eccentric are reached, any further attempts in the direction of expansion will result in loss unless we enter the field of the adjustable or automatic cut-off engine.

To still further illustrate the effects of steam lap, cut-off, and distribution with one set valve, reference is made to Fig. 4, wherein a slide valve is shown with 1 inch steam lap at each end, and with the exhaust lead and compression modified by changing the cavity within the valve. Fig. 5 shows the motion diagram for this valve, and the essential difference from Fig. 2 may be seen at a glance. Fig. 6 shows the indicator diagram from such a valve. In Fig. 5 it will be seen that the cut-off takes place at 18¼ inches from the beginning of the stroke; the exhaust at 1⅛ inches from the end; and the compression at 22⅝ inches on the return. The travel of this valve in Fig. 4 is 4 inches.

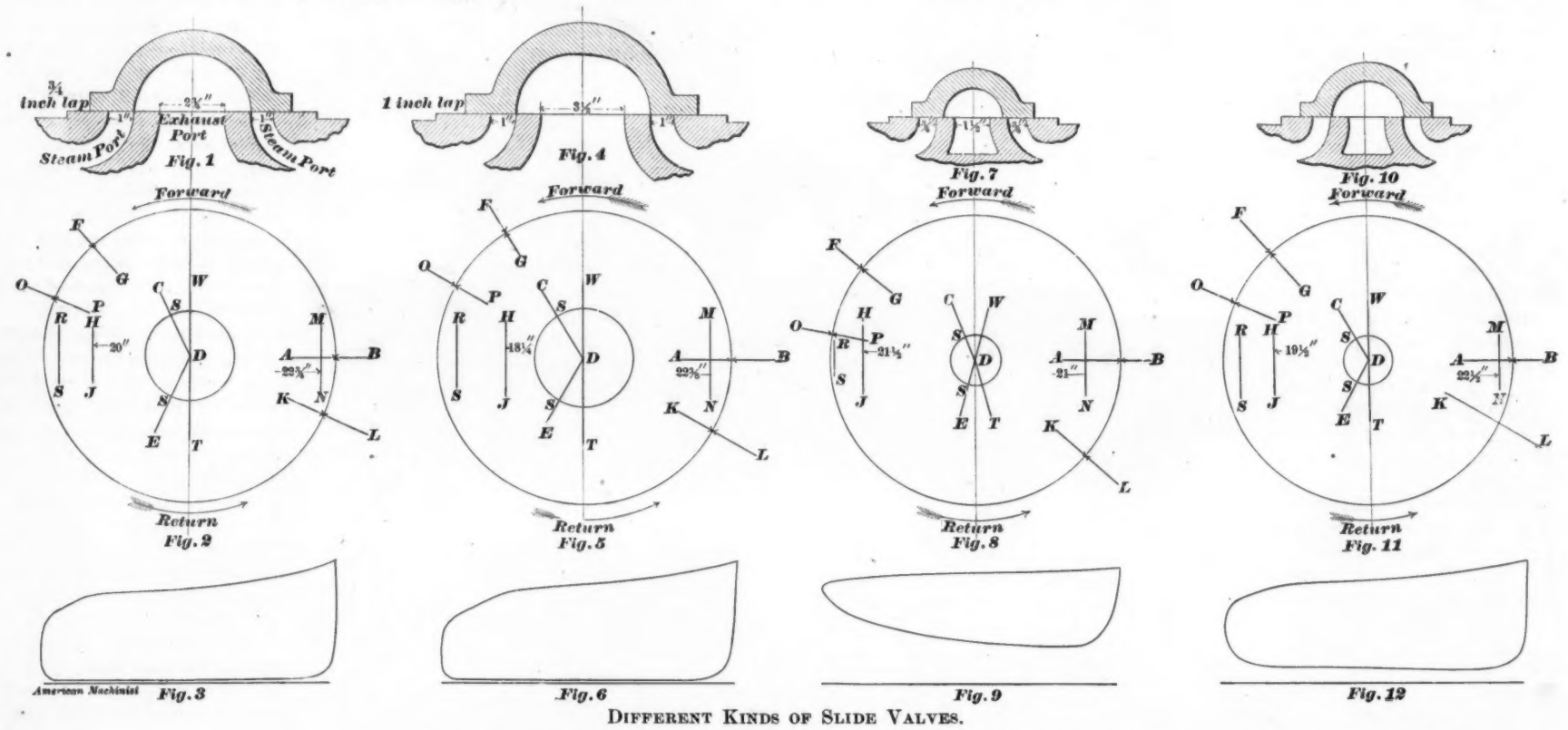
As an illustration of a slide valve badly proportioned, attention is asked to Fig. 7, which shows one of the valves belonging to a hoisting engine. A dispute had arisen as to the power of the engine to hoist a certain load, it having been built under a contract, but in some way, in the hurry attending its completion, it escaped a trial calculated to demonstrate its capabilities. At first when the trouble commenced it was claimed by the engine builder that the steam gage was inaccurate, the engine being situated at a considerable distance from the boiler plant, although the steam pipe was thoroughly protected. Assuming that the gage was right, and the chances seemed that way, a brief calculation showed that there were grounds for believing that the steam did not get a fair chance at the piston, and it was finally determined to bore holes for indicator attachments. The results of the indicator application proved that whoever laid out the steam ports and valves had a very feeble conception of their requirements. The difficulties could not be altogether removed as the arrangements of cylinders, ports and steam chests were too radically out of the way; but a very considerable improvement was effected as the diagrams will show.

Fig. 8 represents the motion diagram, made upon the same scale as the preceding ones. Fig. 9 is the indicator diagram taken before any alterations in the valves had been made, and Fig. 12 shows the improvement in the steam distribution after increasing the steam lap by riveting a strip of metal at each end, and also by cutting out the edges of the exhaust cavity. After the best results were obtained that seemed possible, a new valve was made as shown in Fig. 10. The steam chest was too short, and the cylinder ports too close together to permit of increasing the outside lap any further. The same letters in the motion diagrams, Figs. 8 and 11, indicate corresponding points in the previous motion diagrams, Figs. 2 and 5.

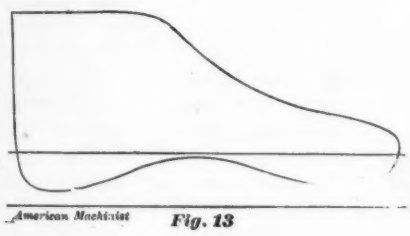
The steam and exhaust lead before changing were both ⅛ inch, too much for the steam and far too little for the exhaust. After the alterations in the valves were made, although the added lap prevented a wide opening of the steam port, the gains in exhaust action more than compensated for any losses in getting the steam into the cylinder.

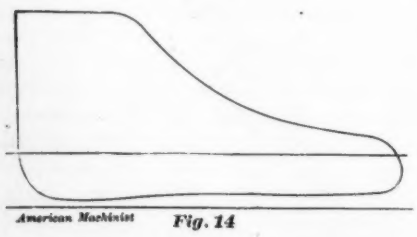
Slide valves may be found with the width of ports and the stroke of the valve so out of proportion that the exhaust opens and then partially closes again on account of the following edge of the exhaust cavity nearly crossing the central port. The result of this error in design is to increase the counter-pressure near the mid-stroke of the piston, and this, of course, represents a dead loss of power. A most curious example of this effect is shown by Fig. 13, a diagram taken by the writer from a plain condensing pumping engine, with a piston speed of 150 feet per minute; the cut-off was accomplished by a small adjustable valve riding upon the back of the main valve. Imagine the effect upon the diagram when a mill engine is fitted up with such a valve, and running at say 400 to 500 feet per minute. It was found that there was a plenty of room in the steam chest, and other conditions were favorable to changing the valves and ports for the better. Fig. 14 shows the results of a moderate amount of outlay, which not only indicates some little saving in steam, but the engine worked smoother and could be run about 15 per cent. faster.

And so examples might be multiplied, but the subject is hardly important enough at this day and age to justify further space, although there are no doubt slide-valve engines being built even now, capable of showing worse diagrams than any herein produced; in fact, the writer suspects that he could pick out a certain line of small engines, extensively sold, in which the indicator would reveal a very wasteful state of affairs.



Different Kinds of Slide Valves.



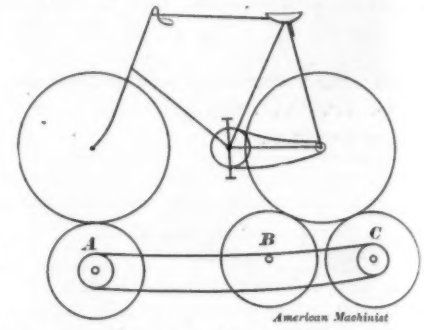


The exhaust opens when the piston has traveled to within 1¼ inches of the end of its stroke, the eccentric being at *T D;* and finally the exhaust on the return stroke closing at *M N*, or 22¾ inches of the return, leaving 1¼ inches of the piston's motion for compression. The crank pin would be at *O P* when exhaust begins, and at *K L* when compression commences. The indicator diagram under fairly good speed, produced by such a valve, should be about as shown in Fig. 3. The total movement or stroke of this valve would be 3 inches in each direc-

Edward Wilcox, a locomotive runner, who was a personal friend of Abraham Lincoln's and drew his funeral train from Washington to Chicago, died at Michigan City on the 14th inst.

"Why Does a Bicycle Stand Up?"

We do not propose to re-open the discussion of the problem, "Why does a bicycle stand up?" but it will be remembered that Mr. Oberlin Smith, who started the discussion in our columns by his article published in our issue of November 15th last year, advanced the idea that a rider keeps his machine upright by constantly bringing the line joining the two points of support under



the center of gravity. That is to say, when, by a slight tipping of the machine, the rider begins to fall to one side or the other, he simply so steers the machine as to bring the points of wheel contact (with the ground) on a line vertically under the center of gravity again, and thus restoring his equilibrium. Though it seemed to us that the action of centrifugal force caused by curvilinear motion of the wheel and rider most readily explains the matter, we yet thought it would be extremely difficult to prove Mr. Smith's theory to be erroneous. Various correspondents tried it, and though some of them offered equally plausible theories, they did not disprove Mr. Smith's.

We have recently seen an illustration of a device used in a French cycle factory for testing finished machines. Its general arrangement is shown by the accompanying diagram, in which *A*, *B* and *C* are supposed to be hollow cylinders mounted in journal boxes in a frame so that they will revolve freely, their width being about four feet. Rollers *A* and *C* are connected by sprockets and a chain. The man who is to test a machine simply runs it onto the rollers to the position indicated, holds himself upright by grasping a standard placed at his side for that purpose, until he gets the wheels and rollers in motion, and after that rides and maintains his upright position by the steering wheel exactly the same as though riding on the ground, though as a matter of fact he is making no progress whatever, but only, so to speak, moving the ground which supports him. It is evident that there can be no centrifugal force acting here to maintain or restore equilibrium, because there is no motion of the bicycle except a lateral one upon the rollers by which lateral motion the line joining the points of support is

brought under the center of gravity whenever there is a tendency to fall either way. It will be understood that the rider drives the wheels and rollers by pedalling in the usual manner.

A Novel Shaper.

In previous issues we have given some account of the Morton shaper that "cuts backwards," and we now present a view of one of these shapers built for a special purpose and in use in the shops of the Dry Dock Iron Co., Bay City, Mich.

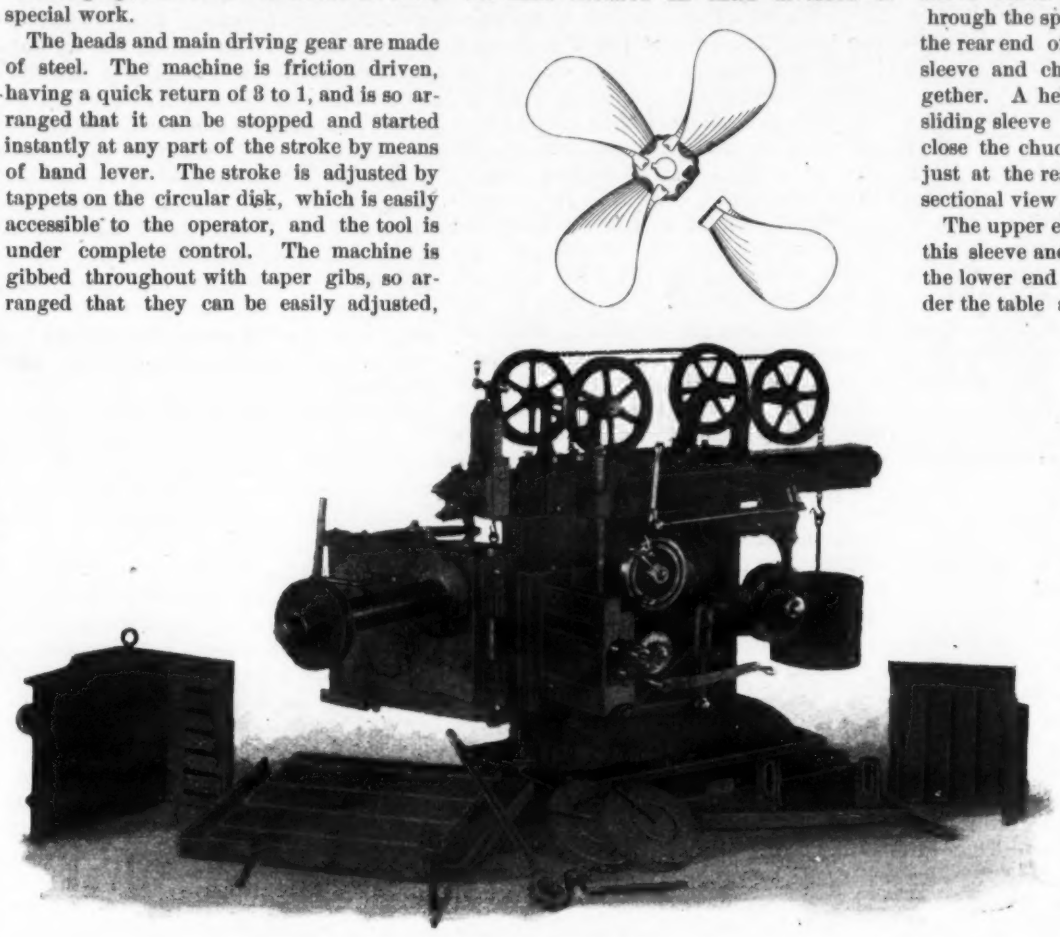
The odd appearance of the machine results from the method adopted to counterbalance the knee and attached parts—made necessary by reason of its special features.

The D. D. I. Co. make a sectional steel propeller wheel, the blades of which are fitted to the hub by planing in the latter dovetailed slots which are planed at the proper angle to give the required pitch of propeller. The bases of the blades are planed to fit these slots, and a key fitted to the base of each blade secures it in place.

Our illustration shows the machine arranged for planing the angular dovetailed slot in the hub, which is placed upon a sleeve and supported upon the projecting stud seen in front of the machine, which stud is fitted with a sleeve that can be indexed by notches on the inner flange as shown.

This stud instead of being attached to the saddle direct is fixed in an apron which can be set at any desired angle, in a horizontal plane, up to 45 degrees and then fastened, thus giving the desired angular setting for propeller hub. Our engraving shows the swinging apron set at an angle.

The large angle plate shown at the left is used for holding the blades, and is placed in position by removing the sleeve, which is used for hubs. This angle plate is also provided with a quadrant, representing a vertical point and 10 degrees of bevel each way. A pit is placed in front of the machine, and the blades placed in an upright position and secured to the angle plate. By this means the required bevel is given to the sides of the blade as well as cutting the

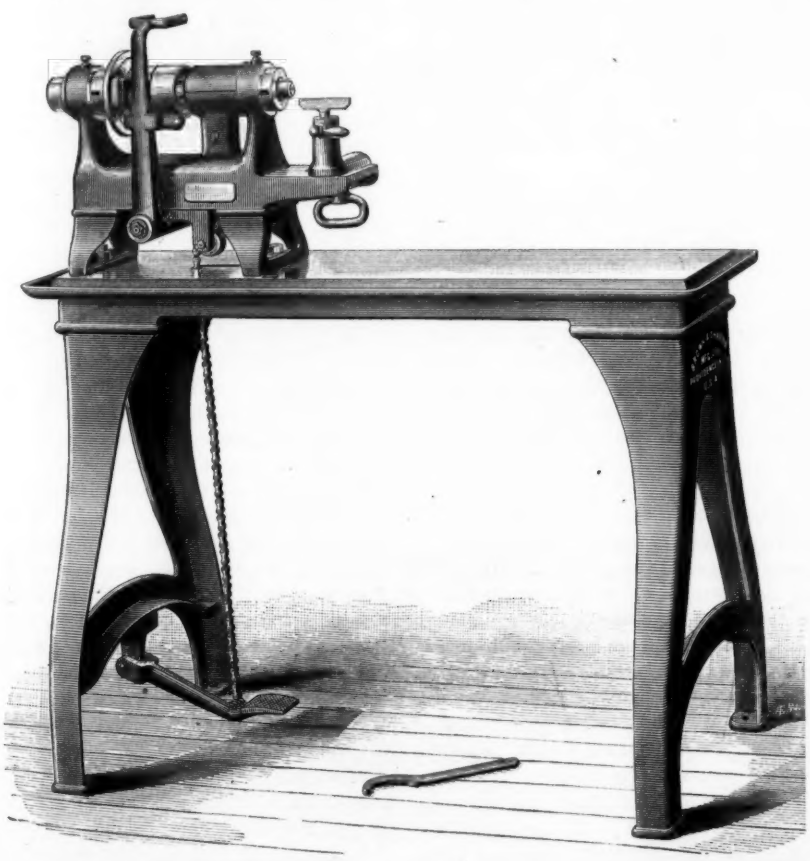


A NOVEL SHAPER.

whatever the position of the table. The machine is heavily geared throughout, and has a capacity to handle very heavy work. Its stroke is 42 inches.

It will be understood that the cut is taken when the ram moves backward, the tendency thus being to hold the various parts of the machine more firmly together during the cut instead of to dismember them.

We have seen a letter from the D. D. I. Co. in which they speak of the success of



POLISHING AND FINISHING MACHINE.

keyseat at the one setting. These special chucks may be removed, and the machine equipped with the regular appliances for general work. The table of this machine, with top plate removed, forms a double angle against which work can be placed and squared in all directions, as well as forming a small table for the vise and other small and medium work. The ram is made of steel, cast hollow and square, and ample provision is made for taking up the wear of the ram. It is bored at its extremities for receiving special tools for inside or other special work.

The heads and main driving gear are made of steel. The machine is friction driven, having a quick return of 3 to 1, and is so arranged that it can be stopped and started instantly at any part of the stroke by means of hand lever. The stroke is adjusted by tappets on the circular disk, which is easily accessible to the operator, and the tool is under complete control. The machine is gibbed throughout with taper gibs, so arranged that they can be easily adjusted,

the machine and mention its great efficiency for this work as compared with the planer which they formerly used. This shaper was built by the Morton Mfg. Co., Muskegon Heights, Mich

It would seem that the cotton-mill industry is not in a very bad way in the United States. Thirty-one of the thirty-six mills at Fall River, Mass., with a capital stock of $21,800,000, recently declared quarterly dividends to the amount of $432,875, and one of the mills declared an extra dividend of $100,000, making the total $532,875. The average quarterly dividend for the total capital of the 36 corporations of the city is 2.54 per cent. without including the extra dividend mentioned.

Polishing and Finishing Machine.

We present herewith engravings of a machine designed especially for finishing and polishing the ends of such work as can be held in a spring draw chuck for this purpose, and the arrangement is such that by depressing the foot treadle the chuck is opened, the belt shifted to the loose pulley, and a brake applied to stop the spindle, the reverse of these operations taking place automatically when the treadle is released.

The spindle is of steel, hardened, ground and lapped, and runs in bronze boxes, the front box being provided with means for taking up wear. The spindle has a ½-inch hole through it and at the front has a special taper hole to adapt it to the chucks.

The chucks used are split in the ordinary way, and on the spindle there is a sliding sleeve which by a stud passing laterally hrough the spindle is connected directly to the rear end of the split chuck, so that the sleeve and chuck move longitudinally together. A helical spring placed under this sliding sleeve tends always to draw in and close the chuck. This mechanism is seen just at the rear of the front bearing in the sectional view of the head.

The upper end of a forked lever *A* spans this sleeve and moves it upon the spindle, the lower end of the lever being carried under the table and connected by the chain to the previously mentioned treadle.

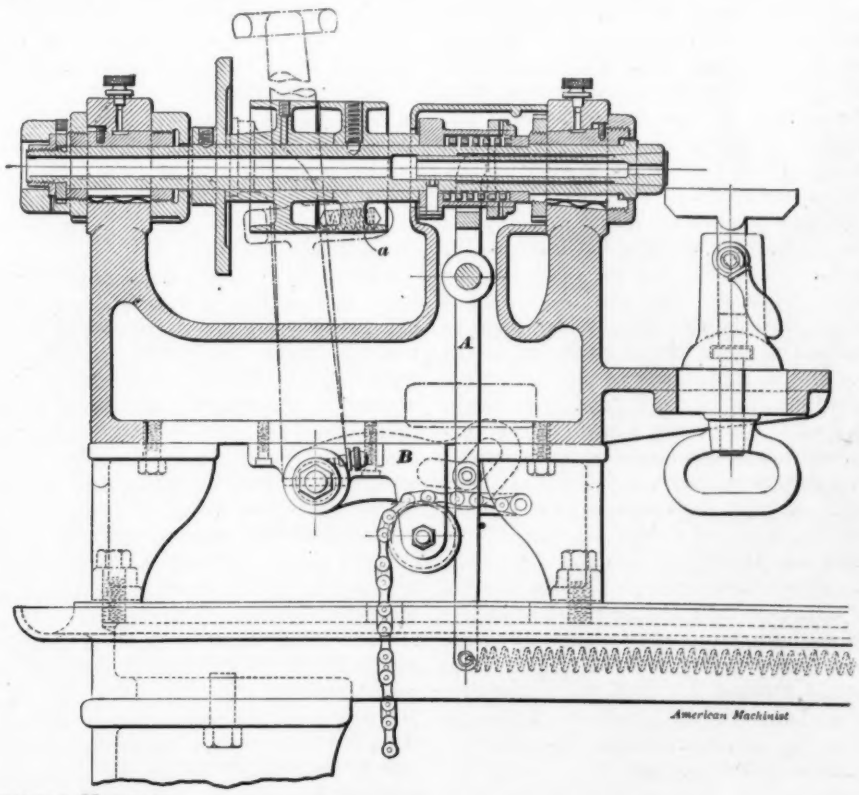
A roller upon the lever *A* engages the curved slot in the lever arm *B* and thereby moves the lever *C*, at the upper extremity of which is the belt-shifting fork, and this lever *C* by means of the helical spring *a* moves the lever behind it, to which last-named lever is attached the brake which acts upon a disk placed on the spindle for that purpose.

The machine is placed upon short legs so that the operator may sit in a chair or upon a low stool and by means of the mechanism described both hands are free for handling work and tools.

There is a countershaft which also has tight and loose pulleys. If it is desired, a foot stock with spindle worked by lever can be supplied, suitable for tapping nuts with long shank nut taps, or for shaving the heads of screws.

In the latter case, if desired, the spring chucks can be fitted with helical spring inside to automatically eject the screws when chuck is opened.

The machine swings 9½ inches over the table, which is 40 inches long and 12 inches wide. It is made by the Brown & Sharpe Mfg. Co., Providence, R. I.



Oil for California Locomotives.

In California, where petroleum is cheap and coal is dear, the oil is being rapidly adopted as the fuel for locomotives. In a short time all the locomotives of the Southern Pacific system at Oakland, Alameda and Berkeley will be oil burning, and probably many on the main line. The Southern California Railway has 12 engines already burn-

ing oil and is preparing to equip all its engines in the same style. The oil used is the thick crude oil from wells near Los Angeles which costs 25 cents per barrel, and it is estimated that at 75 cents a barrel it would still be as cheap as coal at $4.50 per ton, the present price to the company.

The problem of using oil for fuel upon locomotives is not confined to the burner alone. The oil may be burned economically but may be too destructive to the boiler. Upon the steamer "Piedmont" oil was used for a time with great satisfaction, until one day it was noticed that the heads of the rivets were burned off, when the boilers were immediately repaired and no more oil was burned in the furnaces. Improved methods of directing the intense heat of the oil flame have since been generally adopted.

Early Engineering Reminiscences—III.

By George Escol Sellers.

In 1842 and '43 my elder brother and I were in Cincinnati manufacturing lead pipe by hydrostatic pressure from fluid melted lead by a process I had patented of cooling the central mandrel with steam, and the outer die by currents of water at the proper temperature. The cooling by steam is no anomaly, with steam at 212 degrees, and melted lead at, say, above 420 degrees. In addition to our lead pipe business, we were manufacturing rivets from wire, and were contemplating works to make our own wire, with the intention of using the Tennessee charcoal blooms. The importance of uniform iron, free from flaws, for the billets for the wire rods requiring a higher lift and more penetrative force than could be had from the hammers in use in the Tennessee bloomeries, induced me to design the friction lift, and I constructed a working model for experimental purposes.

About this time a Philadelphia and New York firm were manufacturing lead pipe by pressure out of lead in a semi-melted state under an English patent taken out in the United States. They conceived the idea, although my patent was for the use of lead in a melted state, that we were infringing their rights and really using it in the semi-melted or plastic state, but they claimed that even our use of it in a fluid state was an interference with their monopoly, and a controversy arose which might have required settlement in the United States courts but for an examination into the process. An agent came to Mr. Josiah Laurence, who was a partner with us in the business. Mr. Laurence brought him to the works and asked if I would allow him to show our machine in operation. "Certainly," I replied, "on one condition. When lead pipe is coming from the machine and being cooled on its reel, I shall shut off the steam and water, when the pipe will break, and if melted lead is ejected and the pipe be resumed on again turning on the water and steam, the charge of infringement shall be withdrawn, and all legal proceedings stopped." This being agreed to, the gentleman was taken into the works, which were then in operation. As he stood looking at the pipe, I advised him to change his position, as I was about to turn off the water and steam, but he did not heed me, and in an instant the pipe broke, followed by a dash of fluid lead, which fortunately did not burn, but pretty well splattered the gentleman's clothes, and as he expressed himself satisfied, I turned the matter over to Mr. Laurence, and it resulted in the sale of my patents to the Eastern firm, when we immediately commenced the erection of the Globe Rolling Mill and Wire Works; then the high lift hammer became a necessity.

About this time accounts were published of the successful working of Nasmyth's steam hammer in France, and its introduction in England, but with these accounts came news of difficulties in the connection of the piston rod to the hammer, the upsetting of the piston rod, etc., no doubt all exaggerated. I decided on a hammer of from 1,200 to 1,500 pounds weight, with an extreme lift of 6 feet. Miles Greenwood was then carrying on a foundry and machine shop in Cincinnati, and doing a large business in the way of hinges, locks and general hardware, including annealed or malleable cast-iron. Though not himself a practical inventive mechanic, he could see and was always ready to avail himself of suggested improvements. He had often amused himself with my model hammer, and was interested in my account of the drop forging of the Birmingham gunsmith. He proposed adapting it for portions of his locks and hardware. At that time he was making a portion of the machinery for our wire mill. He proposed to get up the patterns for my friction-lift hammer, and as it would be some time before the mill would be ready for it, he would put one up in his shop, adapted to be used either as a common forge or drop hammer. As this would give me an opportunity to practically test the friction lift, I at once made the drawings, and as Greenwood had fixed on an 800-pound hammer, he concluded to use the castings from the patterns intended for my hammer of more than double the weight. This hammer was very hurriedly put up, and was located in the smith shop, close to a partition that divided the shop from the room in which the molding and casting of hinges and hardware was done. Knowing the nature of the ground on which Greenwood's works stood, much of it having been a dumping ground for street cleanings, I proposed a pit to the solid ground, and either a crib or a large, solid, white oak log set endways for the anvil to rest on, with heavy cast-iron anvil blocks. This advice was not followed. From a neighboring pork-packing establishment was procured a sycamore block about 3 feet long, 4 feet diameter, intended for a butcher's block. This was sunk in the floor, and an anvil not exceeding 300 pounds was secured on it. The guides for the hammer were not upright frames from a base, but were suspended from timber work above, and came down to about 18 inches above the anvil, thus giving a clear space to handle heavy work on the anvil. I was called to witness the first trial, which was on a pile for a steamboat wheel shaft. A special reverberating (?) furnace was put up for heating. While the hammer was working to the entire satisfaction of the head smith, complaints came from the casting room that the jar was so great that they found it difficult to pour the metal, but this was not the worst of it, for the breakage by the jar in the sand molds made the bulk of that day's work a total loss. This did not discourage Greenwood, for he said he would arrange so as to use the hammer only after the day's castings had been made. I do not recollect his ever having had dies made to use it as a drop hammer.

On erecting the Globe Rolling Mill on the banks of the Ohio, a considerable portion extended beyond the perpendicular bank, the foundations being from the sloping gravel river bank. It was on this portion that my hammer was erected on an 8-inch square limestone pier coped with a cracked chamber of my hydraulic press from the lead pipe works, weighing over a ton, utilized as an anvil block. The face of the anvil was 18 feet above the foundation on compact gravel, and the arrangement of the hammer and guides was similar to that of the one at Greenwood's, giving a clear space around the anvil. The hight of lift was adjustable by the hammer man during the operation, so that balls taken from the boiling or puddling furnace could be manipulated without serious loss. There were many hundreds of tons of telegraph wire made from puddled iron, consolidated under this hammer with a low percentage of breakage in the drawing process, not more than when the Tennessee charcoal bloom was used, and the works got a high reputation from the freedom from flaws of its boat and small rod iron. On a change of ownership of the works, this hammer gave place to squeezers to save the expense of a hammer man, and to increase the yield by wrapping cinder into the iron produced.

Stillman, Allen & Co., of the Novelty Works, New York, undertook the introduction of the friction lift hammer, and erected a very heavy one to forge shafts, cranks, etc., for ocean steamers. From some cause or other, I do not know what, this was not a success, and it gave place to a Nasmyth steam hammer, which was then being successfully introduced into America by Samuel V. Merrick, of Philadelphia. At a later period Mr. Wm. Sellers put up and used for a number of years a friction lift hammer in their smithy. As nearly all I have written of the history of the friction lift hammer belongs to a period of nearly, if not quite, half a century ago, the speed of its introduction in general use at the present day may be a text for thought to the progressive mechanic.

It was the result of my experience with the hammer that led me to design my locomotive for overcoming heavy grades by means of auxiliary steam cylinders operating horizontal wheels that gripped a central rail, the force of the grip being regulated by the weight of the train being drawn. I do not now propose to say anything of the labor, care and anxiety that invention caused me. It is too unending a net to get into.

On my visits East, I had frequent conversations with Mr. Horatio Allen as to the state of applied mechanics in the West, particularly in regard to the navigation of the western rivers. He had conceived the idea that the form and construction of the steamer hulls lacked the elements of strength, and that their high-pressure steam engines, with two flue boilers, were fuel wasters. He admitted that the East had successfully copied and profited by the western experience in their grand upper saloons and cabins, and he thought that the West ought to profit by the experience of the East in the construction of hulls, and the use of low-pressure condensing engines. I think it was about the time that the Novelty Works were constructing the engines and machinery of the Collins Line of ocean steamers, that Mr. Allen made a hasty visit to Cincinnati. If my recollection is not entirely at fault, the principal object of this visit was to look into the modes adopted for cut-off valves, and the use of steam expansively on the western steamboats. At that time first-class engines were being constructed at the works of Yeatman & Shields, and also by Anthony Harkness. I went with Mr. Allen to see both of them. He seemed greatly surprised at the simplicity of the arrangement of the poppet valves on one side of the cylinder for the induction; on the other for the exhaust steam. Both sets of valves lifted and seated by rock levers operated by cams instead of eccentrics on the main shaft, the cams operating on the parallel sides of a yoke, and always filling the space between these parallel sides, no matter in what position. I think it was while Mr. George Shields was explaining how the cam problem had been experimentally solved, that someone came in and reported a sudden flood coming out of the Licking River, opposite Cincinnati, and carrying with it fleets of barges and other craft that had been tied up there as a safe harbor. We went to the landing, and got there just in time to see a large stern-wheel steamer come out, no steam up, and beyond the control of the watchman, supposed to be the only person on board. The Ohio was rising and full of floating drift, and many whole trees with their roots. The boat swung round as it came into the Ohio, and struck sideways amidships on one of these floating masses, and as she was forced on it, we could see the center of the roof with pilot house and texes hump up, and Mr. Allen exclaimed, "There is one of your weak, frail tubs broken in two." He watched the boat as it floated down stream with the drift, expecting to see it sink, but before it turned the bend below, we saw a tug that had gone in pursuit make fast to it. The afternoon of the following day I was going with Mr. Allen to one of the Louisville mail packets to introduce him to Captain Summons, one of the oldest and most reliable commanders on the river. As we walked along the landing, I pointed out to Mr. Allen a stern-wheel boat that I knew to be the one we had seen coming out of the Licking River the day before, and knowing the captain, who owned and ran the boat (she had a sign up for freight and passengers for the lower river) I took Mr. Allen aboard that he might learn the amount of damage done in the encounter with the mass of drift. To the inquiries Captain M. replied: "If an advance to a higher grade in insurance risks is a damage, that I have got." The underwriters, in consequence of the lightness of my hull, always classed me too low. Now, as she stood what she did yesterday, they have placed her as A 2; it ought really to be A 1. The breaking of two hog chains allowed the boat to spring instead of making a hole in her bottom." Captain Summons was plied with questions about size of hull, tonnage, size of engines, boilers, paddle wheels, consumption of fuel, and all that kind of thing, and copious notes were taken. The captain invited us to go with him on his down trip until we should meet the up-coming packet of the same line. Much of the time of the trip, considerably over a hundred miles, was spent in the engine room. At the first landing on the down-river trip to exchange mail, put off and take on passengers with their baggage and some freight—with a rapid current—it was amusing to see Mr. Allen's surprise at our method of putting in. He expected to see the great boat round-to to make the landing, but instead, the speed was checked, and the landing made with the bow down stream, held in place by a man at each engine commanding each paddle wheel by signal taps of a bell from the pilot at his wheel; then the backward turn of one wheel backed the bow out, and the downward course was renewed. In fact, the entire trip was one surprise after another. The command and management of the floating palace was as near perfection as possible. On our return, Mr. Allen said emphatically that his observation had convinced him that, taking everything into consideration, the waters to be navigated, and all the requirements in connection therewith, there had been as much, if not more, true engineering and mechanical skill displayed in meeting the case as in the most elaborate work on river, sound, or ocean steamers of the East.

At a later period he visited me in Southern Illinois, when I was engaged in paper making from the cane fiber. This time he came by rail from New York to Evansville, Ind., intending to take the Evansville and Cairo mail packet to our place, but seeing one of the great New Orleans boats at the landing, out of curiosity he went aboard and met the captain to whom I had introduced him years before on the boat driven out of the Licking River. The recognition was mutual. On learning that he was *en route* for my place, the captain invited him to become his guest, saying that he should make the landing as he had some packages to deliver to me, but not before some time the next morning, as he had large quantities of corn to take on at intermediate landings, while by the packet line the landing would be made about midnight. His acceptance of this invitation gave Mr. Allen another opportunity to study the management of a first-class western steamboat, and during his visit to me, he expressed in stronger terms, if possible, his belief in the engineering and mechanical skill that had met and would meet every conceivable circumstance or combination of circumstances. To me there is nothing marvelous in this, for our forefathers who settled this continent were intelligent and enterprising men, or they would not have encountered the personal sacrifice and danger of expatriation. They brought with them all the knowledge possessed at that time, and in applying this knowledge under the changed circumstances surrounding them, modifications were a necessity, which very necessity made them self-reliant, and it is but natural that their progeny, brought up amidst these trials, should in turn become not only self-reliant but progressive, and the fathers of a race that has made America what it is in the world of mechanical science.

Before closing I will mention an instance

told me by Mr. Hollibird, who was at that time carrying on a foundry and machine shop in Cincinnati, to show how a trusted employe could resort to expedient to save his employer from heavy loss. Mr. Hollibird had contracted to put up a sugar mill for some Louisiana planters, and the contract called for a separate engine of quite small size as compared to the larger one required to run the rolling machinery; this smaller engine being designed to operate the boiler, feed pump and to run a few tools in the repair shop. After the machinery was erected an accident happened to the larger engine, the piston rod breaking and the back cylinder head and part of the cylinder being broken off. The difficulty of obtaining a new cylinder from Cincinnati in time to work off the crop when the season was already well advanced was apparent, and although every effort was made to hasten the order forward, at a time before the telegraph existed, yet the case seemed almost hopeless. The engineer, however, determined to try a few experiments as to the possibility of utilizing the smaller engine, even if he should have to decrease the amount of work per day, that is, run the rolls slower and run the small engine a great deal faster than was intended. The minute detail entered into as to his method of arriving at the conclusion as to what might be done, and his ingenuity in effecting the necessary changes with little or no facilities for doing the work, was an instructive lesson. The experiment was so successful that in a few days the mill was put to work, and the working off of the crop had advanced so far before the new cylinder arrived, that they concluded to finish that year's work before replacing the broken cylinder and re-attaching the larger engine to the sugar-mill plant.

What interested me in regard to this millwright was that he was one of the old-fashioned workmen, used to working with wood and iron, having very little scientific knowledge in regard to steam, and yet the line of argument that led him to advise the attempt to utilize the steam engine was instructive and showed the value of such a workman, who evidently warranted the high appreciation of his services expressed by Mr. Hollibird, whose reputation was protected, and the interest of those who were buying his machinery made the dominant interest of the workman, who, to effect this purpose, had worked almost unremittingly, day and night, until he accomplished what he made do, with only the help of slaves who had been trained to rough mechanical work, and in a country where there was no stock of material at hand to perfect the change. Even the belts he had to improvise were made from rawhides bought from the planters about the neighborhood, scraped, dressed and softened, and sewed together with strips cut from the same material.

Tracing the origin of any important invention has always been to me a most difficult task. A want of something is discovered often at widely distant points. Minds are at work to supply it, and it is natural to suppose that more than one should conceive the same idea. I will relate a case in point. The faces of laid paper molds were always hand work done on the face of the mold frame, and up to this time had been done by my grandfather and my father's youngest brother; to avoid this tedious hand work, to weave these laid faces was the object, and my grandfather and my father made plans and constructed a machine for the purpose. The work done by it was very perfect, but as constructed, the tangling of the warp wire that had to be twisted at each seam as the face wires were laid was so troublesome that there was not much gain by its use. My father was not aware that his father had been giving very much thought to this machine, as in the beginning he had rather discouraged him from undertaking the construction of it, but it occurred to both of them simultaneously, in a manner that was quite startling in its simplicity, that by turning the machine over the difficulty would be overcome, and this was immediately tested and found to be entirely satisfactory. The coincidence of invention in this case, from the records made at the time, was so evident that neither could claim priority as to this phase of the development of the machine.

Turning the machine upside down involved the necessity of sets of fingers to raise and hold the wire being laid to place while the twist in the warp was being made, the tightening of the double-warp wires by suspended weights with pulleys on their suspension ends, speeding the work so that these weights should only turn as the twist, and not go beyond, all of which was doubtless thought out by both of them.

One more instance of mutual thought entirely independent of each other. At the time that machine-made paper was fast superseding that made by hand, a pulp dresser or screen—an English invention—to take knots out of the pulp, was an appendage to each machine. Such a device was also required for the pure, clean pulp in the vats where the finer and more costly hand paper was made, and there were several mills running in the vicinity of Philadelphia that called for such an improvement. One Sunday morning father had gone out to his father's in the country, and I, with the rest of the family, went to church. While thinking I was paying due attention to the sermon, I fancied that I saw a process that would screen pulp for the hand vat, with finer screens than used in the English process. On reaching home, I went into the play shop and constructed a portion of a model, sufficient to show the process. When my father returned in the evening I showed it to him, when he asked when I had first thought of it, and on being told, he showed me sketches of a very similar arrangement which he had thought out as he rode from the city in the morning. After one was put in operation in Jos. Robinson's mill on Darby Creek, it was decided to patent it, and father proposed a joint invention. I objected, however, on the ground that father had an hour or two priority, and the patent was issued in his name. No effort was ever made to introduce the device in the few mills in the vicinity. When I went to England in 1832, intending to look into the state of paper-making machinery of that period, I took with me one of these pulp screens, with the intention of seeing the Whatmans, who at that time supplied most of the hand made drawing paper of the world. Bryan Donkin, then the principal paper machine builder, who had introduced the English pulp screen and was requiring the paying of a royalty to the paper-maker inventor and patentee, examined my machine, and asked the privilege of consulting with the English patentee, assuring me that no advantage would be taken by its exposure. To this I could have no objection in the case of a man to whom Sir Walter Scott has referred in one of his works as "Honest Bryan Doncan, the paper-maker." This conference resulted in my disposing of the right to take out a patent of introduction for £50 and a royalty, which in time amounted to a little more than the expenses of my trip abroad.

There is scarcely a limit to the number of cases that could be cited where inventions have been made to supply needs as they have occurred at widely separated places without any concurrence of the inventors.

Occupation as a Social Standard.

Someone called an American, by name Casper Whitney, has been writing of sporting matters, and he says:

Not only am I of opinion that English amateur rowing would not occupy the high place it does to-day were it not for this definition (the exclusion of mechanics, artisans and laborers), but, strange as it may sound to our American ideas of democracy, I believe we must adopt some very similar ruling if we ever hope to attain a correspondingly high standard. . . . No one rejoices more than I at evidence of the lower classes turning their attention to sport. It is a magnificent spectacle, of incalculable value to national manhood, and would that it applied to the whole world. None is more democratic than I. I am more than willing to help my laboring brother of lesser refinement; to do all I can for him in his worthy efforts to attain a sound mind and a healthy body; give him advice, time, aid, and to encourage in every possible manner his endeavors to make more of a man of himself. But I do not care to dine or play football with him.

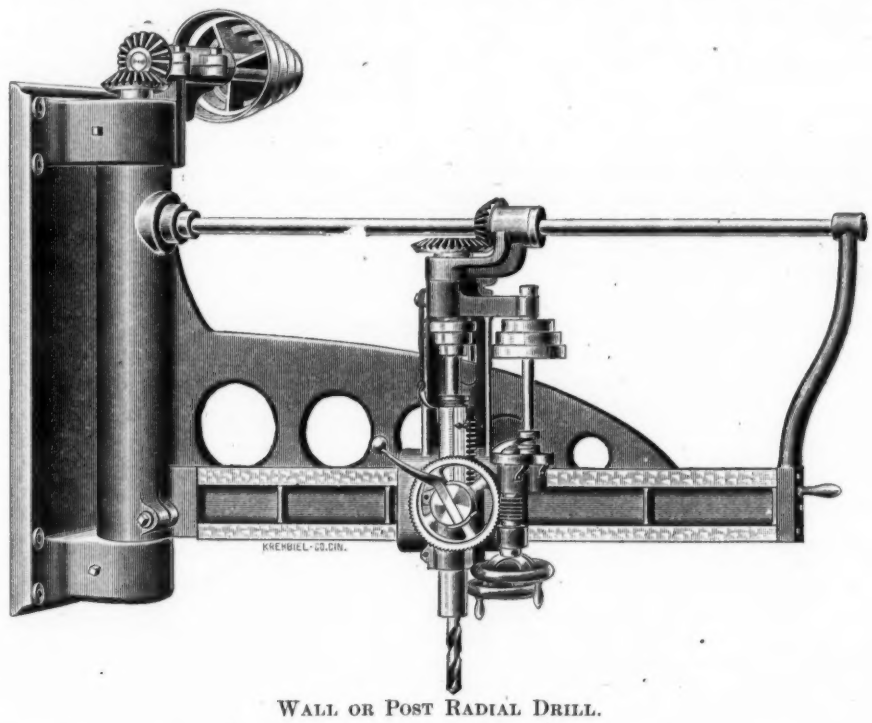
This is a free country, and life is too short to waste time in fruitless endeavors. The laboring class are all right in their way; let them go their way in peace, and have their athletics in whatsoever manner best suits their inclinations. There is no reason on earth why they should play under our rules, or why we should open our rules to admit of their more liberal understandings of an amateur. Let us have our own sport among the more refined elements, and allow no discordant spirits to enter into it.

Perhaps the best criticism of this we can make is found in the London letter of Harold Frederic, published in the New York *Times* of August 11th. He says:

The case in question arose in the Badminton country, where the Duke of Beaufort presides over a specially fast sporting set, and his son, the Marquis of Worcester, was so busy all his life with dogs, rats, otters, and the like, that he never had the time to marry, much less to learn how to spell. When some random sense of need for intellectual diversion chanced to pervade this set a while ago, its women folk fell to circulating obscene anonymous letters among themselves, showing them to the men with the view of blackening one another's character and setting the males by the ears as well. This is often a favorite amusement in bored country-house circles, but they carried it at Badminton to a point where it entertained the whole district. It might still have been going on if two ladies had not lost their tempers and dragged the thing into the law courts here, where they and their titled friends were on exhibition for a single day. They revealed such profundities of stupidity, falsehood, vulgar manners, and debased standards of morals that the pressure to shut them up became overwhelming, and the squabble was settled overnight.

These people being neither "mechanics, artisans nor laborers," would not only not be excluded from participation in sporting events, but on the contrary, it is such as they or their influence that exclude the classes mentioned. Probably Mr. Whitney would feel honored by being allowed to mingle socially with these people, but there are lots of American mechanics and their wives who would disdain to have anything to do with them, and the whole thing shows the utter stupidity of attempting to decide by a man's occupation whether or not he is a fit associate in a rowing match or other sporting event.

Mr. Whitney had better take up his residence permanently at Badminton, or—soak his head thoroughly. The simple fact that there are refined and pleasant people both in and out of the aristocracy, and that there are also the other kind of people in every walk of life, seems incomprehensible to some minds.



WALL OR POST RADIAL DRILL.

Wall or Post Radial Drill.

We illustrate herewith a machine designed for drilling, reaming, etc., in boiler, bridge and ship-building shops, etc.

The bracket which supports the radial arm can be bolted to a post or to a wall, or, if put up in a gang, clamped fast to two flat lying I-beams. The head is movable on the arm by means of rack pinion and hand wheel, and can be securely locked.

The arm can be secured rigidly to wall plate by means of a clamping screw. The spindle has power feed, hand feed, quick return motion and automatic stop. The machine has four different speeds and three different feeds for spindle; spindle is counterbalanced. The following are the general dimensions: Distance between bearings on wall plate, 3 feet; length of wall plate, 4 feet 4 inches; width, 16 inches; length of radial arm from center of trunnion to end, 6 feet; vertical range of spindle, 10 inches; cone pulleys, four changes, 6, 8, 10 and 12 inches diameter; width of belt for cone pulleys, 3 inches; size of tight and loose pulleys, 14 inches by 3¼ inches. The machine is built by the Bickford Drill and Tool Co., Cincinnati, Ohio.

LETTERS FROM PRACTICAL MEN.

No Oil on Bicycle Bearings.

Editor American Machinist:

Do not oil your ball bearings. Having given this advice to a bicyclist, he in return advised me to go where it was warmer and bicycles not in use.

To not oil the bearings of a bicycle seems, at first glance, to be absurd, yet, nevertheless, is correct; the bicycle bearing is a slow-running bearing, having a speed of about 60 to 80 feet per minute, and being exposed as it is to all kinds of dust, will collect the same, and the combination produces an excellent grinding paste, which shows its action on the balls and races by giving them a fine matted finish.

I have used my wheel (English make) for two seasons without oil; the balls and races are as bright and true as when turned out of the shop, being absolutely free from marks of any kind. I keep all bearings well screwed up, having no play whatever, yet other bicyclists claim that my wheel is too free running.

I should like to hear from others on this subject.

THOMAS GRANT,
41 Maiden Lane, N. Y.

Radial Icicles—Trolley Car Brakes.

Editor American Machinist:

Mr. Dunbar's letter on this subject in your issue of August 1st interested me somewhat, and although not one of the parties appealed to for a solution, I venture to offer a suggestion. The statement that water leaves a revolving body, when due to centrifugal force, at a tangent line to the circumference, is, perhaps, true enough when the observer is not revolving with the wheel. Should the observer, however, embark on a merry-go-

round, and spill some water or beer, for instance, on the circular platform that contains the wooden specimens from natural history, I think the liquid would appear to him to fly off in a radial line, should the machine revolve fast enough, although to persons standing on *terra firma*, it would seem to go off in a tangent. I have not tried this experiment, but should think the radial icicles would go to prove that the water really does fly off in radial lines, freezing into a cold fact without regard to appearances.

In the same issue I notice an editorial on the trolley car brake and its injurious action on the motor mechanism if applied too quickly, and it occurs to me to ask what would be the particular crime in applying the brake directly to armature shaft instead of car wheels? Also, if placed there, it wouldn't get slippery in wet weather, nor get any sand to wear it out quickly, besides which, I think it would require less muscular exertion on the part of the motorman to apply it.

Walter Gribben.

Use of the Monkey Wrench—Solid-End Wrenches.

Editor American Machinist:

There is something rather "pat" about the heading, "The Safety Valve on the Monkey Wrench," and under this heading I find food for thought and suggestion; and to more clearly illustrate where the safety valve can "blow off" and relieve the wrench, I send a sketch of a monkey that has been in my possession since 1869, and I believe I can truthfully say it is as good as the day I bought it, with the exception of bruises here and there and wear in nut and screw, and they got these by hard work.

The point I want to make is this: A monkey wrench is susceptible of hard work and a long life if properly handled, and is just the reverse if improperly handled.

How many mechanics are there who appreciate that there is but one way to use a wrench of this kind and not abuse it?

Judging from observation, I venture to say that not 50 per cent. stop to think but that the wrench will stand as much wrenching one way as another, yet a glance at the scrap pile or a walk around among the benches of a shop will show you that somebody has abused the monkey; and it goes without saying that some manufacturer has been correspondingly cussed because he made such poor tools.

I believe you will find that nine out of ten wrenches that give out, break in the back of the eye to the movable jaw at *A*, and this only occurs when you *pull up* on the wrench when placed as in Fig. 1, and never when forcing down, as in Fig. 2. If circumstances are such that you must pull up, then turn your wrench over, and you get the effect of Fig. 2, which is the only proper one, excepting, of course, certain contingencies when one has no choice, and then you must take the chances of a broken wrench.

The diagram drawn on the two wrenches, Figs. 1 and 2, shows where the strains are transmitted when the wrench is properly used, as in Fig. 2, or abused, in Fig. 1.

These strains are increased or decreased, according as the wrench is made to fit the nut on which you are wrenching; and the practice that some mechanics have of only approximately setting the wrench to fit, is not only bad for the corners of the nut or head, but is bad for the wrench also.

I can't close this subject without saying a word about the practice, in some shops, of permitting the use of a screw wrench for everything. This, too, in shops that are turning out standard machinery of one kind or another, requiring hundreds of black or finished nuts, all of one size it may be, and yet the screw wrench (usually the monkey) does all the business, and for 99 per cent. of this work it is extremely unhandy and clumsy, to say nothing of marring the finished work.

I inclose a drawing, Fig. 3, of a light but strong, malleable iron wrench that I have had a long time, and is one of a set furnished by one of the large machine shops in Jersey to every mechanic they employ, and the time saved in handling work with it will make up for its extra cost over and above nothing in some shops, and a poor cast-iron wrench or a monkey wrench in other shops.

These wrenches are all stamped in the mold with their sizes for both ends, and they fit every time, and a closed wrench of this description beats a screw wrench of any kind out of sight for all the work going through a shop, and for outside work the screw wrench, as against this malleable iron wrench, simply "isn't in it," and a mechanic in the shop before mentioned would as soon leave his hammer behind as to leave a set of these wrenches behind when going out erecting.

The case would be somewhat different if they were a heavy, clumsy tool, but they are not; although light and nice to handle they are very strong, rarely breaking except when some smart chap uses one as a hammer; even then there is some redeeming portion left, for they quite as often snap off close up to the head under such abuse, and you have a good single-ended wrench left.

Excuse my having so much to say on this simple subject, but if it will influence one mechanic to treat his wrench as he should where he has been accustomed to treat it as he should not, or influence him to discard it altogether for a large per cent. of his work, in favor of a more suitable tool, I shall be quite satisfied, and feel that one person at least has abandoned an eighteenth century trick for twentieth century intelligence.

Orosco C. Woolson.

Newark, N. J.

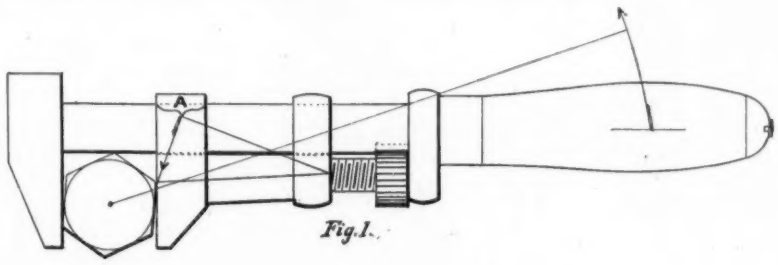


Fig.1.

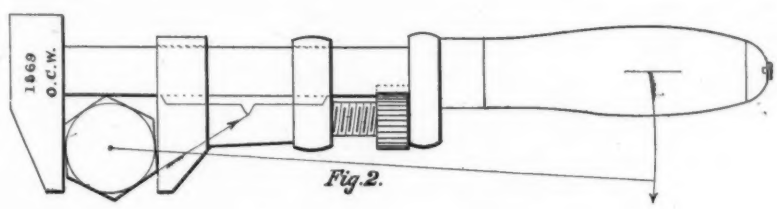


Fig.2.

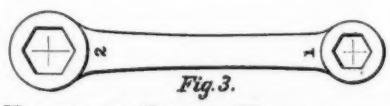


Fig.3.

Use of the Monkey Wrench.

The Cost of Castings.

Editor American Machinist:

Referring to my previous letter in reference to cost of castings, which was published August 1st, and your remarks on same, I am afraid I did not make my meaning clear in the matter of the cost of the sprues, etc. It seems to me that the cost of sprues as given, .0176, has gone into them less, perhaps, a small amount for labor in molding, which could not be charged against the amount dumped from the cupola after molds are filled. This amount is so small and the actual figures so difficult to get, that I have neglected them.

Under the head of sprues, I include everything, gates, bad castings, etc., that was returned to cupola from the previous heat; and while I am willing to admit that their actual cash value is less, I fail to see why they should not be charged at what they cost.

A misplaced decimal point made me give the cost of coke ten times too much; it should be $2.60, but this, of course, does not affect the question at issue, and I am still,

A Blockhead.

The Cost of Castings.

Editor American Machinist:

In your issue of August 1st a contributor signing himself "A Blockhead" (why did not he use a *nom de plume?*) shows how he figures up the cost of his castings, and you partially correct him, but you leave the most ridiculous item of his statement untouched.

You are unquestionably right in considering such materials as "bad castings," "gates," "sprues" and "dump" to be of scrap value, no matter whether they appear on one side of the account as "charge," or on the other side as "product." But where does this foundry operate which uses coke costing $26 for 650 pounds? This is at the rate of $80 per ton for coke. At any point in this country where pig-iron can be had at $.0066 per pound, or about $14.75 per ton, coke should be procurable for about $3 per ton of 2,000 pounds, and the value of 650 pounds of such coke is about 98 cents.

The account should then stand about thus:

"Charge."		Product.	
300 lbs. pig-iron, at $.0066 =	$1.98	1,347 lbs. bad castings, gate, etc., $.005 =	$6.73
710 lbs. car wheels, at $.005 =	3.55	3,945 lbs. good castings, $.0144 =	57.23
3,800 lbs. scrap, at $.0045 =	17.10		
870 lbs. sprues, at $.005 =	4.35	5,292	
5,680 Totals	$26.98		
Coke, 650 lbs., at $\frac{3.00}{1000}$	.98		
Labor	36.00		
Total	$63 96	Total	$63.96

Thus making the cost of the good castings $.0144 per pound, instead of $.0208, as you make it. It is somewhat doubtful if the quantity of coke is correct as given. In small heats, such as this, a ratio of 7 or 8 to 1 is very good practice, and 800 to 900 pounds of coke for such a melt would not be extravagant. Still this would not materially affect the cost of the castings.

There are a great many little items of expense in a foundry, such as sand, flour, molasses, wire, chaplets, core irons, nails, flask lumber, etc., which belong to the cost of producing castings, and which will amount to nearly 10 per cent. of the total cost of iron, coke and labor; so that $.0144 \times 1.10 = .01584$ would be the *shop cost* of such castings. To this must be added the *loading* expenses, such as clerk hire, rents, insurance, taxes and general expenses, all of which must be met before any profits ensue. This *loading* depending on each individual case, as a matter of course.

I could wish that some of our competitors in the foundry business might adopt the method of cost keeping, which your contributor uses. It would have the effect of advancing prices. Castings are selling too cheap, anyhow.

Wm. A. Bole.

Pittsburg, Pa.

Centrifugal Force—Radial Icicles.

Editor American Machinist:

In your issue of August 1st, I am asked by Mr. J. H. Dunbar to explain why the icicles, which in cold weather are formed on a revolving grindstone or emery wheel in exposed situations, "are formed radially rather than some other shape—a spiral, for instance." I cheerfully comply with this request, so far as I am able to do so.

I have never witnessed this particular action, but have frequently observed the oil which had worked out on the side of a new car wheel, where it may always be seen extending in radial lines from the hub. This action seems to be similar to the formation of radial icicles, and both to admit of the same explanation. In both cases we observe a fluid which is still adherent to the revolving body, since when water leaves the surface to move on in the tangential direction, it does not all leave, but the surface remains wet. The question presented then is: "What will be the behavior of a fluid which remains adherent to a revolving body?" Experiment proves that it will simply take the highest radial position. If water be applied to a revolving ball, it will accumulate at its highest line. This is a very instructive experiment, the ball being caused to revolve only at such a speed that the water will not leave the surface. If oil be substituted in the place of water, the ball may be rotated more rapidly, and the oblate figure, formed by the accumulation of the oil on and near the highest line before its cohesion is broken, that is, before its deflection from the straight line of motion requires to produce it a force sufficient to overcome its cohesion, will be more marked.

So if a body be revolved at the end of an elastic cord, it will revolve in a larger and larger circle as the velocity is increased, until the cord breaks, when its radial stress or resistance to deflection ceases, and it moves on in the tangential line. So we see that any motion of which any part of a revolving body is capable, so long as the centripetal bond continues unbroken, must be on a radial line.

This would call for the accumulation of ice in a continuous ring around the grindstone, the water that remained adherent when the principal portion was thrown off being frozen. The formation of icicles instead of a ring may, perhaps, be accounted for in this manner. Projections, however minute, in the surface of the stone would cause correspondingly higher accumulations of water at those points, and these would then tend to grow, all the water tending to them more and more strongly as they increased. The form of the icicles must be an interesting feature. I apprehend they must be large at the base.

Charles T. Porter.

Bolt Tension.

Editor American Machinist:

If "Superannuated" had known that my letter on the subject of "Bolt Tension" was written about the same time as his concerning "The Safety Valve on the Monkey Wrench," although published in a later issue, he would have also known that my letter was not in any way a criticism of his. If he will do me the honor to consider once more my comparison of the cylinder head to a safety valve (which has nothing to do with a safety valve on the monkey wrench) and the bolts to the spring of the safety valve, he will see, I think, that the initial stress on the bolts, collectively, like that on the spring, *must* be greater than the pressure of steam upon the cylinder head (valve), or otherwise it will leave its seat.

How much greater the collective stress must be than the steam pressure to make the joint tight I will not try to be so "fine" as to say, even approximately, as I should imagine that it made considerable difference whether the joint were wide or narrow, made with a rubber gasket or a copper one, or metal to metal; whether it was scraped

true on both cylinder and head, or rough-turned on both; whether the cylinder and head were both the right shape, so that the full stress of the bolts came on the joint or not, and some other little details of that sort, which are probably too "fine" for "Superannuated" to take any notice of, but I feel tolerably sure that it must be greater, and that "Superannuated's" assumptions as to the amount of stretch and compression are, therefore, while interesting, superfluous. Furthermore, I think it would not be difficult to find engines of high reputation, where the cylinder head joint is correctly designed, and the joint-making stress relatively small in consequence; in which the initial stress on the bolts and the stress due to steam pressure are *each* up pretty close to the safe-working stress, and therefore their sum pretty well up to twice that stress, and if it is necessary, as "Superannuated" says, to deduct the initial stress from the safe-working stress to find the stress due to steam pressure that the bolt will safely stand, then I would like him to explain how those engines continue to avoid the scrap heap.

As for a safety valve on the monkey wrench, it has always been my experience that the spring of the jaws supplied a good deal more of that element than was strictly necessary, and that the place where the safety valve was most apt to be wanted was on the user's feelings.

Longdale, Va. J. E. JOHNSON, JR.

An Inquiry About Steam Expansion.

Editor American Machinist:

A short time ago I read a description of De Laval's steam turbine, and of the way that it operates. It was an interesting description, but I was somewhat surprised to read that it used steam expansively, and wish to ask if this statement is correct. It will be remembered that in using this machine steam is simply blown out against it, the turbine being so made that as the steam strikes it a rotary motion is imparted in a way somewhat similar to that in which water causes some kinds of water wheels to revolve. As the steam issues in one continuous blast, where does the expansion come in? It is true in a certain sense that all engines use steam expansively, including the full-stroke throttling machine, for if steam were not expansive we could not use it at all, or at least in the way that we do, and with the same results, for in that case it would not come out of our boilers at all. It is also true that when steam is confined under pressure, and then allowed to escape into the atmosphere, it does expand so that its velocity is increased, but does this fact warrant us in saying that this turbine uses steam expansively? Let us review briefly what is meant when we speak of a motor using steam expansively. In the case of the ordinary steam engine, the steam is admitted during a portion of the stroke, the supply is then cut off, and what is already in the cylinder is allowed to expand to the end of the stroke.

But this is quite different from opening a globe valve in a steam pipe, and allowing the steam to rush out in a continuous stream or blast. Is it proper to claim that this steam turbine used steam expansively? It may be claimed that when the steam leaves the pipe and strikes against the turbine it imparts to the latter the velocity due to the increased velocity of expansion, but again I ask, is this proper? If steam flows into the atmosphere, where it encounters no resistance but the atmosphere, at a certain rate, does it flow at the same rate when striking against an iron machine, and doing useful work in that way? Two men may be holding the nozzle of a hose, delivering a stream of water on to a fire. As long as the water is delivered freely into the air they hold the nozzle easily, but if they turn it so that the stream of water strikes a brick wall at short range, what will the consequence be, will there not be a backward movement somewhere? Again, suppose that this nozzle is fastened to a stout post by a swivel joint so that it can be turned in any direction, but cannot be thrown backward. Let us now try the same experiment as before. The nozzle cannot be thrown backward, but as there is a thrust on it, does it not show that the velocity of the water is reduced? Does it not affect the escape of steam in the same way?

We are told that the steam turbine is an efficient machine, and if this is true, is it not because there is no cylinder in which to condense the steam while it is yet under pressure? When steam issues from a pipe in a continuous current, and immediately does its work, it has but little chance to return to water, until after its mission is accomplished; and if this is not an important consideration in the use of this machine, I should be pleased to be informed of it, and until then I will let the matter rest in the form of an inquiry. W. H. WAKEMAN.

Pressure on Crank Pin.

Editor American Machinist:

Mr. W. H. Wakeman scarcely bears out the title of his paper, "Facts for Young Engineers," when dealing with the subject of pressure per square inch on a crank pin (page 629, August 8, 1895); for, instead of stating "facts," he lightly touches on certain questions which he leaves unanswered, and makes sundry references without arriving at any definite conclusion.

With all due apology, therefore, to Mr. Wakeman, the following line of consideration is suggested for "young engineers," and also any others who may be in doubt concerning the area resisting pressure applied to a crank pin.

(A) Consider the piston at the commencement of stroke with full steam load on, but

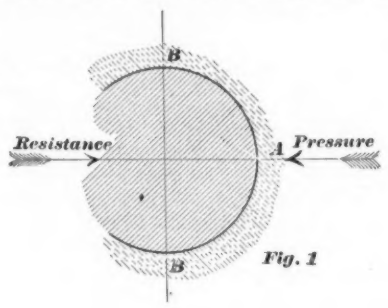


Fig. 1

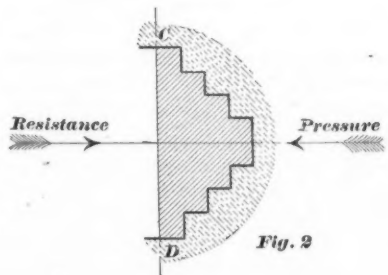


Fig. 2

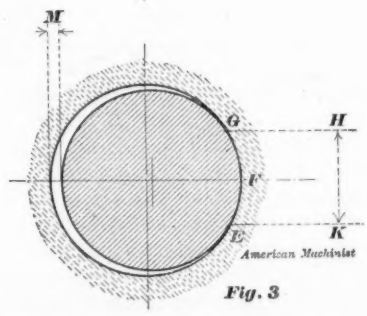


Fig. 3

the engine at rest. Now, whether we regard the pressure and resistance as forces acting along the central line, or conceive a number of lesser forces acting parallel to the central line and at regular distances apart, the same result may be observed; namely, in Fig. 1, a point *A* in which the action takes place on a surface at right angles to the lines of pressure, and points *B B* where no resistance can possibly take place because of the surfaces being parallel to the line or lines of force. It may not be strictly correct to refer to parts of a circle as being at right angles, or parallel, to lines of force, but a due regard for the limits of the parts considered will prevent any misunderstanding. Consequently, the degree of resistance with reference to unit area of contact surface will vary from the highest at *A* to zero at *B*. And if the whole of the contact surface, *B A B*, be resolved into its vertical and horizontal components, the vertical parts, or the resisting surfaces proper, will be found to aggregate an area equal to the product of the diameter of the pin multiplied by its length. And the general conclusion, therefore, with reference to such surfaces under pressure is, that the actual area resisting pressure is the aggregate area of the projection of all points in contact, the projections being made parallel to the lines of force, and on a plane at right angles to the direction of the forces.

(B) Another illustration may make this clearer to the "young engineer:" Since we are supposing the engine at rest, the conditions will not be altered if we conceive the crank pin contact surface to be that indicated by the section, Fig. 2, the surface being composed of vertical and horizontal parts. In the section, the sum of the horizontal lengths to the right of *C D* equals the sum of the vertical lengths; and since the latter equals the length of the diameter *C D*, the total length of line of contact equals twice the diameter. But this line of contact is no more a factor in the resisting area than the half circumference was in the last consideration; and surely no one will claim that the horizontal surfaces in Fig. 2 are concerned in the work of direct resistance. Clearly, then, the vertical surfaces alone resist the pressure applied; and these will be found to aggregate an area equal to the product of the diameter of pin multiplied by its length.

(C) Consider the case of a loosely fitting pin where the contact surface is only a part of the curve, as at *E F G*, Fig. 3. Now, applying what has already been shown, the resisting area in the case of Fig. 3 will not be the length of the pin multiplied by the length of the arc *E F G*, but the area due to the length of the pin multiplied by the length of the chord *E G*, or its projection *H K*.

Regarding pressure on the oil: This, of course, will be the same as that on the opposing surfaces, and will vary, per unit area of contact surface, from the highest at *A* to zero at *B*, Fig. 1. But the pressure per square inch of projected area will be the same at any part.

It may not be out of place to call the "young engineer's" attention to the fact that a sufficiently large pin—large as to diameter multiplied by length, when properly fitting in its box, seldom gives trouble on account of "heating." Experience has shown within certain limits what the pressure per square inch should be (preferably not to exceed 900 pounds per square inch of projected area), and any excess of pressure, whether due to increase of load, or decrease of projected area, is liable to produce "heating." This may be shown by comparing Figs. 1 and 3. In the latter case the projected area is only one-half that of the former, and, other things being equal, the pressure per square inch will be doubled, thus intensifying the heating effects on the opposing surfaces, and aggravating the trouble by impoverishing the possible results of the lubricant.

Another trouble with a loose pin, as in Fig. 3, is that known as "knocking." This is familiar to all, but it may have a further interest for some because of its measurable character. The "knocking" is produced by the pin or box striking opposite sides, and changing point of contact, as from *F* to *N*. In any case this will occur at the beginning of each half stroke, and there may be additional occurrences due to excessive fluctuations in speed. Evidently, the loss of energy due to this defect will be represented by the total resultant piston load multiplied by the distance *M*. Consequently, in addition to the work done against crank pin, frictional resistance is the direct loss of this appreciable amount of energy plus the damage done to the parts receiving the hammer-like blows. G. W. SCOTT.

Ravenswood, Ill.

Strength of Gear Teeth.

Editor American Machinist:

Permit me to make a few comments on the table for "The Horse-power of Spur Gears," published over the signature of "M. E.," in the MACHINIST of August 15th.

I do not wish to appear hypercritical or censorious, but I am compelled to say that the table referred to reminds me of "Looking Backward" more than anything since the day of Edward Bellamy.

It took me not quite half a minute to place my hand on the "twenty-three different rules" to which I think "M. E." refers, and which I found at once in a collection made by my old friend, Mr. John H. Cooper, of Philadelphia, and published by him in the *Journal of the Franklin Institute* for July, 1879.

Mr. Cooper analyzes these rules, and works them all out to their results from the basis of a gear of 5 feet diameter and 3 inches pitch, with face 2.5 times pitch, the usual allowance, or 7.5 inches, and making 60 revolutions per minute.

	H. P.
From the formula of Boulton & Watt he gets	66.17
" " " " Carmichael (1814) he gets	47.06
" " " " Robertson (1814) he gets	56.09
" " " " Buchanan (1841) he gets	53.18
" " " " Tredgold.	80.78

Now these old formulæ are always supposed to allow ample strength for "corner contact," and in the data from which Boulton & Watt's rule is formed, given by Mr. Cooper, the factor of safety, or excess over breaking strain, is plainly shown to be 15 to 1. This should certainly be a sufficient allowance for such cases. Now from "M. E.'s" table the power to be got from such a gear at one revolution per minute is 0.456, or at 60 revolutions, 27.36 horse-power, and if we follow his calculations and multiply three-fourths of that by 2.5 for the width of face, we only get 51.3 horse-power, or less than any of the old rules except "Carmichael," even for full contact of the teeth.

I shall not attempt to follow "M. E." in his calculations, but he says he allows 1,000 pounds for the stress on the material, while Boulton & Watt only allowed 480 pounds.

Now in 1890 I had to make some calculations for a pair of gears to transmit 600 horse-power and referred to Mr. Cooper's paper, which he had sent me long since. Looking over the Boulton & Watt rule, I decided to work out a new one for myself on the basis of 7,500 pounds, as the breaking strain, and 500 pounds for the safe one, on a cast-iron cube of 1 inch, and a face of 2.5 pitch, the gears being in full contact, but of one tooth only. I made such a formula and from it deduced a result of 149.226 horse-power, which I found to agree very closely with that from Jones & Laughlin's rule of 147.27 horse-power, Nystrom's rule for *two* teeth of 295.59, and Haswell's of 138.23 and 163, which average 150.61 horse-power. This convinced me that all these old formulæ made ample allowance for corner strain, and as no sane man would now put up gears with the intention of running them in that way, and no good mechanic would allow them to run so, I can see no value in a table which reduces the power of gears to one-third that allowed by Boulton & Watt.

I afterwards worked out for my own amusement a full gear table, which was published in the *Journal of the Franklin Institute* for September, 1890.

I submitted my formula to the late Jas. B. Francis, who pronounced it "*amply safe*," and gave me his own short rule for determining the thickness of a tooth, which is $\sqrt{\text{pressure in pounds}} \times .020$. This is simple enough, and comes very near mine, allowing the thickness to be 0.47 pitch.

SAM'L WEBBER.

E. J. Whittaker, a retired officer of the Engineer Service of the United States Navy, who served on the United States man-of-war "Minnesota" in the late war, participated in the battle between the "Merrimac" and the "Monitor," and with Farragut in the Gulf blockade, and at the Fort Fisher engagements, died at Sackett's Harbor, N. Y., on the 21st inst., aged fifty-six. He was born at North Adams, Mass. He was placed on the retired list May 9, 1895, having, in the closing days of his service, been Fleet Engineer of the North Atlantic Squadron.

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Higher Wages.

We are informed that too much fuss is being made about advances in wages, that the excessive agitation of the subject, and reading numerous reports of advances, are making workmen uneasy and dissatisfied, so that they are loading the desks of their employers with requests for increases, most of which cannot be granted. It is suggested that we should write an editorial deprecating this condition of affairs.

We very much regret that any manufacturer should find himself unable to grant an asked-for increase of wages, and wish that every one of them were so prosperous as to make him feel as though he must raise wages, whether asked to do so or not. But we cannot with a clear conscience affirm that we are sorry that men are asking for increased wages. Nor do we believe that any manufacturer who really thinks about it, can place his hand on his heart and say he wishes all workmen would be satisfied and content to get along with whatever wages they may happen to be receiving. There are countries where workmen are apparently entirely satisfied. They work along from year to year upon wages barely high enough to sustain life, and seem to have little or no ambition to better their condition. Are manufacturers better off in such countries than they are here where they are troubled with ambitious workmen, constantly striving to better their condition? We trow not.

What is it but the ordinary process of barter that fixes the ruling rates of wages, the same as it fixes the ruling rates of payment for about everything else? The man who has anything to sell gets the highest possible price for it, and the man who buys, buys as cheaply as he can, and no one thinks of blaming either of them, nor do the parties who deal with each other think of feeling ugly about the matter, unless it is labor that is being bought and sold.

A manufacturer who finds that the man he has been buying his iron of wants a higher price for iron, promptly informs him, of course, that he cannot pay a higher price, and that he can buy iron of another at lower figures. In the meantime he looks about, and, finding he cannot really do better, he pays the advanced price—pays it cheerfully, knowing that the advance is an indication of better times, and that his competitors must also pay higher prices for their iron, and that prices of his product must either go higher, or remain at a higher figure than they otherwise would. He does not think of blaming the iron man for asking higher prices; in fact, thinks he would be foolish if he did not. The workman just as much expects other people to look to their own interests, with decent regard for the equal rights of others. But when these two men come together to discuss wages they too often forsake reason, refuse to discuss the matter calmly and dispassionately, fail to recognize that each is justified in presenting his own side of the case as strongly as possible, and in finally refusing to trade, except upon terms that are satisfactory to himself.

It is natural for a manufacturer who is asked for an increase of wages amounting to, let us say, $50 a day increase in his pay roll, to consider that his daily output of work will actually be increased in cost by that amount, and that his margin, which in many cases is undoubtedly too narrow already, will be made that much narrower, and perhaps reduced to a minus quantity. But this by no means always follows. It has been demonstrated many times that increased wages are often accompanied by and seem to cause decreased cost of production. The higher wages attract better and more ambitious men, enabling those who are less efficient and without ambition to be weeded out. More and better brains are applied to the work; and brains count for more than muscle in these days.

There are builders of machinery—lots of them—who are paying fair rates of wages—fully as high rates as are paid by any of their competitors for similar service, who are yet receiving their share of requests for advances. But we do not think this should worry them in the least; it simply indicates that they have ambitious men in their employ, who want all they are worth. If these men are sensible as well as ambitious they will be easily able to discover by a little investigation whether or not a fair rate is being paid, all things considered, and will govern themselves accordingly; but if they are not sensible then they are not worth employing anyway, and had better be allowed to go where they think they can do better.

We believe in the real economy of relatively high-priced skilled labor, and think the true principle is to pay whatever is necessary to pay in order to secure the best grade of labor for the work to be done. We do not believe in the railroads' plan of paying all men doing similar work exactly the same rate of wages. Each individual should be dealt with in accordance with his value in the place he occupies, or can fill; and it should be understood that it is no one's business what rate of wages he receives, except his own and his employer's.

It is to be remembered that, while the interests of a given manufacturer, taken in the narrowest sense, may seem to demand low rates of wages, he is in every way and broadly interested in high wages, the higher the better, and if he assures himself that he is paying at least as high rates as his competitors are paying for the same service, he need fear no serious trouble. But when a manufacturer finds that he really cannot pay as good wages as his competitors are paying, it is time for him to look to his shop organizations, his equipment and methods. It has been demonstrated many times that this is a symptom of decadence which cannot be cured by still further reduction in wages, and such shops have been restored to prosperity under new management that paid higher wages.

But whatever is done about wages, neither those who pay them nor those who work for them should forget that it is always in order to be reasonable, and to listen to the other side of the story.

The Destructive Use of Tools.

The everlasting monkey wrench seems to be asserting its rights to some consideration in our columns just now. A correspondent in this issue gives us a sketch of his wrench that he has used, as he tells us, for years. His treatment of the wrench has evidently been different from that which it receives in many hands. It is reasonably certain that it has done him more and better service than if he had used it less carefully, or, perhaps, it would be more proper to say less correctly. What has been good for the wrench has also been good for the work. The long life of the wrench has been also a useful and creditable life. Nothing, probably, has exasperated us more in the course of our mechanical life than the abuse of the monkey wrench. The customary abuses which our correspondent cites are mostly of such a character that they can be attributed to an ignorance of mechanical principles, or, at the worst, to thoughtlessness. We could have wished that he had gone a little farther, and shown by actual computation how great is the strain thrusting the jaws of a wrench apart when it is not closed tightly upon the nut or bolt head operated upon. The abraded corners of tap and reamer heads are in evidence in too many shops upon this point, and the worn surfaces of the wrench jaws themselves tell the same story.

But in addition to the sins of ignorance and thoughtlessness the monkey wrench fiend continually perpetrates others that are willfully and wantonly destructive. There is the use of the wrench for a hammer. It injures and soon ruins the wrench, and the wrench always mutilates what it is applied to, while it only remotely accomplishes the duty intended. The makers of wrenches are more or less to blame for this practice in continuing to make the head of the wrench in a shape suggestive of a hammer. Metal would be saved by changing the shape, and hammering with the wrench might be rendered practically impossible.

No one ever put a pipe on the handle of a wrench to get a greater purchase that was not guilty of deliberate wrong-doing. Ignorance or thoughtlessness have nothing to do with a case of that character. But the worst crime against the wrench that fiendishly ingenious malignity has ever invented is that of hammering on the back of the handle ferrule. It makes a real mechanic's blood boil to see such an operation as that. Eternally blasted should be the mechanical reputation of any man who could acquiescently stand by and see such an atrocity committed. Incredible as it may seem, however, there is an aggravation that may still be piled upon it all. It is for a man to tell you that it is his own wrench. An outrage is an outrage, and though in our own person or pocket we do not suffer it, we still have sympathies that cannot be entirely benumbed.

This seems to open a rather large topic. A topic too extensive to be treated here. We may say, however, that in our opinion no circumstances and no exigencies of trade can justify the abuse of tools, either the small tools of the workman or the machine tools of the shop. Nothing can justify it because it does not pay, and no good can ever be accomplished by it. The workman or the proprietor who does not respect his tools enough to preserve them in their accuracy and integrity will not respect the product of his tools, and his output will not deserve an honorable place in the market. It is a piece of pure fiction that represents a shop proprietor as going into a deliberate computation of profit and loss and deducing from it the conclusion that it pays to use his machinery in a more or less destructive way; that the loss in the value of his machinery or tools may be made up many times over in the increased amount and value of his product. In machine work the job that permits a machine to be tested to the full capacity of its strength is the rare exception rather than the rule, and the rare job that does permit as heavy cutting as a tool is capable of still does not, therefore, involve an overcrowding of the tool. A properly designed and constructed machine tool for heavy work will carry all the cut that the belt will drive and can do no more than that. As it is constructed in every part to stand that strain upon it constantly, if necessary it will do that very thing day after day and year after year. It cannot be overcrowded or overworked. With an amount of care that should not interfere to reduce its possible output, the tool should be practically as good as new after ten years of service.

As a matter of fact, properly designed machinery wears out slowly, and machine tools more slowly than most lines. They certainly last as long as they ought to as far as their wearing out is concerned. Not one-twentieth part of the machine tool-builders' output to-day is for the replacing of worn-out machinery. Improved machinery in place of the obsolete, and machinery for new purposes and for the extension of productive capacities everywhere give the machine shop of the day almost its entire employment.

The Deadly Soda Fountain, and No Inquest!

In Richmond, Va., a few days ago, a "soda fountain," or, more properly, a cylinder containing carbonic acid under considerable pressure, exploded, killing almost instantly one man and seriously injuring another. The circumstances, as given to the press, show the conditions to have been such as we have heretofore indicated as highly favorable for the occurrence of similar catastrophes. The explosion occurred a little after one o'clock in the afternoon. Two men were taking the receiver from a delivery wagon and allowed it to strike the sidewalk, when it exploded, giving one man a fearful cut across his forehead, down the left side of the face to the jugular vein, which was severed, and of course killing him

in a few minutes. The other man was knocked down and badly injured about the head.

The tank had been exposed to the sun, and the pressure in it had consequently been considerably increased with the rise of temperature, and of course there was nothing like a safety valve about it. The testimony of all the witnesses was that the tank did not fall, and it could consequently have received but a slight jar.

The most incredible part of the occurrence came after the fatal explosion. The coroner arrived and decided "after a careful inquiry" into the cause of the accident that he would not interfere, deeming an inquest unnecessary, for if any one was culpable it must have been those who were wounded.

And this thing is going on all over the country. It is only by the kindness of an appreciative reader that this case is brought to our notice. This is a mechanical journal and this matter may be none of our business, but surely it is necessary to go out of the way if it is possible thereby to help to check such outrageous disregard for human life. It is high time that competent engineers were employed to design these cylinders.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(329) H. B., Philadelphia, asks: In the formula, area of port opening = area of cylinder × piston speed in feet per minute ÷ x, can the following values be used for x: 5,000 for H. P., 7,000 for M. P. and 9,000 for the L. P.? *A.*—Those figures might be used, but it would not be wise to do so. The port area is usually taken as a certain proportion of the piston area, running, say, from one-eighth to one-sixteenth. Your figure for H. P. gives one-tenth for 500 feet piston speed, and that would be sufficient; but the successive piston areas in a triple-expansion engine are usually a little more than double that of the preceding, and with port areas to correspond your divisors should be 5,000, 10,000 and 20,000. In the transatlantic steamer "New York," the cylinder ratios are 1, 2.49 and 6.3, and the port areas are exactly doubled for each succeeding cylinder, this being accomplished by the use of similar piston valves, one for the first cylinder, two for the second and four for the third. 2. Give formula for finding diameter of furnace for either a 1, 2, 3 or 4 furnace boiler. *A.*—This matter cannot properly be embraced in a formula. The best practice is only to be learned by a comparison of the various boilers in use. Furnaces should not be less than 36 inches in diameter, nor more than 48 inches. With one furnace the shell may be up to 9 feet in diameter, with two furnaces up to 13 feet 6 inches, and with three up to 15 feet. The boilers of the "Paris" are 15 feet 7½ inches diameter, with four furnaces 3 feet 3 inches diameter. 3. Name some books that a young draftsman ought to have. *A.*—See answers to similar questions in our issues of January 11, 1894, February 22, 1894, July 5, 1894, and September 27, 1894.

(330) J. A. F., Shamokin, Pa., writes: In answer to Question No. 286, where should the key be placed in a split pulley or fly wheel, you advise the placing of it in the middle of the semi-circle between the joints, and add that care should be exercised to prevent the key from bearing hard against the top of the keyway, as there would be danger of subjecting the bolts to an excessive stress, and if there were danger of the key bearing against the top, it might be better to place it 45 degrees around toward one of the joints, but the half of the pulley could not then be removed without first taking out the key. Now, why would it not be better to place the key right in the joint, and would not that relieve the bolts of nearly all the tensile stress, and could not the top of the pulley be taken off without taking out the key by starting the opposite side of the wheel a little first? *A.*—We have nothing to add to our former answer upon this question. We have almost invariably seen the key placed in the middle of the semi-circle, and have never seen any trouble on account of its being placed there. With the key at 45 degrees, the half of the pulley containing the key could not be taken off without taking out the key; but that is a matter of no importance, as the other half of the pulley could be removed first, and the key would then be slack enough to be removed easily. There are some objections to placing the key in the joint, the chief one, perhaps, being that there is a little uncertainty as to how close the joint would come together, and that would affect the fit of the key. It is better to have the joint a little open and let the pulley pinch the shaft, and then the key usually has little to do. 2. Where can application be made for a position as molder in the U. S. Navy? *A.*—Apply at any navy yard where there is a foundry in operation.

(331) C. E. P., Chicago, Ill., writes: I have a gear or rather a sprocket wheel with 9 teeth and 8-inch circular pitch, and I want to find the pitch circle. I divide 3 1416 by 8 inches and get .3927 inch pitch, and then I divide 9 by .3927 which gives me 22.918 +" for the diameter of the pitch circle. By another method I take the sine number out of Brown & Sharpe's gear book, which is .34202, and then I divide 8 by this .34202 which gives me 23.3944, which is .376 inch, or ⅜ inch more than the first one. Where is the trouble? *A.*—The last division and subtraction above are incorrect. The difference between the first result and that obtained by the second method seems to be the difference between using the arc or the chord as the measure of the circular pitch. If the distance from the center of one tooth to the center of the next is measured along the pitch line, that line in this case being an arc which is one-ninth of the circumference of a circle, then the length of this arc multiplied by 9 will give the complete circumference, and this divided by 3.1416 will give the diameter. But if the pitch is measured in straight lines from the center of one tooth to the center of the next then these lines will form the sides of a polygon, and the circle will be circumscribed about the polygon. The side of a nonagon being 1 the diameter of its circumscribed circle will be 2.9238, and the side in the above case being 8 the diameter is 2.9238 × 8 = 23.3904, which is precisely the result that you would have obtained if you had performed the division correctly. 2. I have books that tell how to get the tangent, co-tangent, secant and co-secant provided I know the sine or cosine; now can you give me the rule for finding the sine and cosine? I have a book of trigonometry, but I am unable to find anything in it. Whether it is in there and I cannot see I do not know. *A.*—Tables of sines and cosines are to be found in the engineers' pocket-books, and probably in your trigonometry. The length of the sine is given as a decimal, the radius being assumed to be 1 and the angle being known.

(332) A. B., New York, writes: Please give principal dimensions of hull and engines of the Sound steamers "Providence," "Plymouth," "Pilgrim," "Puritan," "Priscilla," "Connecticut," "Maine," and "Richard Peck." Also give name of designer of these boats, when and where built, and number of passengers carried. *A.*—The "Providence" was built in 1866. The hull was built by William H. Webb, New York; length over all, 373 feet; length on water line, 363 feet; breadth over guards, 84 feet 6 inches; breadth of hull, 47 feet 6 inches; depth of hull, molded, 17 feet 3 inches; draught of water, light, 9 feet 8 inches; registered tonnage, 2,962; net, 2,064. Simple beam surface-condensing engine, 2,900 horse-power, built by the Morgan Iron Works. Cylinder, 110 inches diameter; stroke, 12 feet; maximum revolutions per minute, 19. Three boilers 35 feet long and 13 feet diameter; grate surface, 510 square feet; heating surface, 13,850 square feet; average steam pressure, 18 pounds. Side wheels, 38 feet 8 inches in diameter, 12 feet wide with stepped buckets. Accommodations for 1,200 passengers. Steamboat "Plymouth": Length over all, 366 feet; length on water line, 351 feet 8 inches; breadth over guards, 87 feet; breadth of hull, 50 feet; depth of hull, molded, 21 feet 8 inches; draught of water, light, 10 feet 10 inches; registered tonnage, 3,779. Four-cylinder double-inclined triple-expansion engine, 5,500 horse-power. The "Pilgrim" was built in 1882, by John Roach & Son, Chester, Pa. Hull of iron, double bottom; length over all, 390 feet; length on water line, 375 feet; breadth over guards, 91 feet; breadth of hull, 50 feet; depth of hull, molded, 18 feet 6 inches; draught of water, light, 11 feet 8 inches; registered tonnage, 3,484; net, 2,512. Vertical beam, surface-condensing engine, 5,300 horse-power, cylinder 110 inches diameter, 14 feet stroke. Boilers of steel, four in number, of the return tubular type, 25 feet 4 inches long, 10½ feet high and 14½ feet wide; total grate surface, 689 square feet; side wheels, 41 feet diameter; speed, 20 miles per hour. The "Puritan" was built in 1888, designed and built under the direction of George Peirce, of the Old Colony Steamboat Co.; the hull was built by John Roach & Son, Chester, Pa.; the engine and boilers were built by W. & A. Fletcher Co., New York, now in Hoboken, N. J. Length of steel double hull over all, 419 feet 4 inches; length on water line, 403 feet 4 inches; breadth over guards, 91 feet; breadth of hull, 52 feet; depth of hull, molded, 21 feet 4 inches; draught of water, light, 11 feet 8 inches; registered tonnage, 4,593; net, 3,075. Compound vertical beam surface-condensing engine, 7,500 horse-power. High-pressure cylinder, 75 inches diameter, 9 feet stroke; low-pressure cylinder, 110 inches diameter, 14 feet stroke. Eight boilers, of steel, of the Redfield type. Grate surface, 850 square feet; heating surface, 25,500 square feet. Feathering side wheels, thirteen steel buckets in each, 14 feet long, 5 feet wide, ¾ inch thick; 360 state rooms, and sleeping accommodations for nearly 1,000 persons. Average speed, 20 miles per hour. The "Priscilla" was built in 1893–4, designed by George Peirce. The hull is of steel, double, built by John Roach & Son, Chester, Pa. The engines and boilers were built by W. & A. Fletcher Co., Hoboken, N. J. Length of hull over all, 440 feet; length on water line, 424 feet; breadth over guards, 93 feet; breadth of hull, 52 feet 6 inches; depth of hull, molded, 21 feet 6 inches; draught of water, 12 feet 6 inches; registered tonnage, 5,292. Double-inclined compound engines, 8,500 horse-power. High-pressure cylinders, 51 inches diameter; low-pressure cylinders, 95 inches diameter; stroke, 11 feet. Ten steel boilers, Scotch type, 14 feet diameter, 14 feet 6 inches long, three furnaces in each boiler; total grate surface, 850 square feet. Feathering side wheels, 35 feet diameter; buckets, 14 feet long. Sleeping accommodations for 1,500 passengers. Speed, 22 miles per hour. All these boats belong to the fleet of the Fall River Line. The "Connecticut" was built in 1889. The hull is of wood, constructed by Robert Palmer & Son, Noank, Conn. Length over all, 358 feet; length on water line, 345 feet; breadth over guards, 87 feet; breadth of hull, 48 feet; depth of hold, 18 feet; registered tonnage, 3,399. The engines were built by Wm. Cramp & Sons, Philadelphia, Pa.; type, double-inclined direct-acting compound oscillating surface condensing engines; diameter of high-pressure cylinder, 56 inches; diameter of low-pressure cylinders, 104 inches; stroke, 11 feet. The feathering side wheels are 28 feet in diameter from center to center of bucket trunnions, 12 buckets in each wheel; length, 14 feet; width, 4½ feet; average dip of wheel, 6 feet. Sleeping accommodations for 800 passengers. The "Maine" was built in 1892 by the Harlan & Hollingsworth Co., Wilmington, Del. Hull of steel; length over all, 310 feet; length on water line, 302 feet 7 inches; breadth over guards, 60 feet; breadth of hull, 44 feet 10 inches; depth of hold, 17 feet 4 inches; average draught of water, 12 feet 6 inches; registered tonnage, 2,395. Engine, inverted direct-acting surface-condensing, triple-expansion; diameter of cylinders, 28, 45, 51, 51 inches; stroke, 42 inches. Four steel boilers, Scotch type, 13 feet 6 inches diameter, 11 feet 6 inches long. One four-bladed propeller, 13 feet 6 inches diameter, 18 feet 6 inches pitch. The "Richard Peck" was designed by A. Cary Smith, New York, and built in 1892 by the Harlan & Hollingsworth Co., Wilmington, Del. The hull is of iron frames and steel plating; length over all, 316 feet; length on water line, 300 feet; breadth over guards, 62 feet; breadth of hull, 48 feet; depth of hold, 18 feet 6 inches; draught of water, 10 feet 6 inches, loaded; registered tonnage, 2,906. Two triple-expansion engines; diameters of cylinders 24, 38, 60 inches; stroke, 30 inches. Six steel boilers, Scotch type, 13 feet diameter, 12 feet long. Two four-bladed propellers, 10 feet 6 inches diameter, 15 feet 6 inches pitch. Average speed, 20 miles per hour.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 692.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Marine Iron Works, Chicago (new catalog).

Patent Solicitor. J. G. D. Mack, Madison, Wis.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work, Ferracute Machine Company, Bridgeton, N. J.

Just issued—Catalog No. 8. Mailed Free. Clayton Air Compressor Works, 28 Cortlandt St., New York.

Wanted—Machinery to build: special steam, mill, hydraulic. F.C. & A. E. Rowland, New Haven, Conn.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Aids to Engineers' Examinations, with Questions and Answers. Price $2, prepaid, catalog free. Theo. Audel & Co., 91 Liberty street, N. Y.

English Railway Racing.

In this slow land of ours we have no such excitements as the racing of railway trains upon the great thoroughfares of travel, but there has lately been in progress in Great Britain a continuous trial and competitive reduction of speed between two great lines of railway over a distance of more than 500 miles, and we find the proceedings described with zest in *The Engineer*, London. The race is between the East and West Coast routes from London to Aberdeen. The West Coast line measures 540 miles, and the East Coast 523 miles, but the two routes are considered to be more evenly matched than these figures indicate. The shorter line is more level than the other, but it has many miles of single line, numerous awkward curves, shorter runs without stop, an additional stop, and the necessity of running the last 40 miles upon the hostile road. The competition in speed has been upon the northward trips, and in the night. Up to July 1st the scheduled time from London to Aberdeen was, East Coast, 11 hours 35 minutes; West Coast, 11 hours 50 minutes. The West Coast shortened its time 10 minutes, and the East Coast at once shortened its time 15 minutes. Then the West Coast knocked off 40 minutes, making their time just 11 hours, and the East Coast cut theirs to 10 hours 45 minutes. The same day the West Coast began running it in 10.35, the East Coast came down to 10.25, and the West Coast at once shortened to 10.20, and further accelerations are highly probable. It is upon record that the run has been made in 10 hours.

Some of the runs are described with considerable detail. On July 22d, a large crowd assembled at King's Cross Station to see the start, at 8 P. M., of the East Coast train, to make the run in 10.45. The load consisted of nine six-wheeled E. C. J. S. coaches, one six-wheeled sleeping car, and one eight-wheeled sleeping car—total weight 179 tons, besides the engine and tender. The first locomotive was an 8 feet "single." Twelve minutes were lost on account of a lamp going out, and for switching to pass a bridge under repair. The second engine, of the same type as the first, took the train 82 miles in 87 minutes. A third engine, a "North Eastern," 7 feet 7 inches, single, made 80½ miles in 86 minutes, running time; then two engines, a 7 feet 7 inches single compound, and a new 7 feet coupled, ran without a stop 124½ miles in 136 minutes. A sixth engine, a new "North British," 6 feet 6 inches coupled, finished the run, 130½ miles, in 160 minutes, and arrived one minute under time.

A West Coast run made at about the same time gave some different conditions. The load was a light one, consisting of one eight-wheeled sleeping car, three ordinary eight-wheeled W. C. J. S. coaches, and one six-wheeled van; total, approximately, 112 tons, exclusive of engine and tender. The noticeable feature was the length of the runs without stop; 417 miles were made with but two stops—a feat never before equaled in Great Britain. The first engine upon this trip was a 6 feet 6 inches coupled, of the "Precedent" class. The first hour's run was remarkable, 58½ miles were made in the 60 minutes, and the greater part of it uphill. Though the train was light a speed of 60 miles an hour was made for many miles up a rising gradient of 1 in 330. This engine made 158 miles in 177½ minutes. A second engine, of the same type as the first, made the first 26 miles in 25 minutes, and 140½ miles in 170 minutes. The third engine was a 6 feet 6 inches coupled bogie. Up a long bank of 1 in 75, its speed never fell below 34 miles an hour. This run was 150 miles in 171 minutes. The fourth engine was another 6 feet 6 inches bogie which made 90½ miles in 102 minutes.

Detailed accounts of other runs are given which it is not necessary to reproduce. The maximum speed attained in these runs was not greater than is often attained by the ordinary express trains on the respective roads. The East Coast once touched 80 miles an hour, and the West Coast 78.

There is not supposed to be any unwarranted risks incurred in these runs, and if there is racing there is absolutely nothing to be characterized as recklessness. The steadiness of the trains at the higher speeds is quite noticeable; in fact, the steadiest running is at the highest velocities. At 70 to 75 miles an hour the steadiness was absolute. The superiority of "bogie" coaches to six-wheeled stock has been made very apparent, and the lesson will doubtless bear fruit.

Our readers will need no assistance in making comparisons with American performance in long runs and high speeds. With our grade crossings we are certainly not assured as safe a line as would be found anywhere in Great Britain.

On August 21st, the East Coast train left King's Cross Station, London, at 8 P. M., and reached Aberdeen at 4.40 A. M., thus making the 523 miles in 520 minutes, or .99426 mile per minute, and the West Coast train left Easton Square at the same minute, and reached Aberdeen at 4.55 A. M., making the 540 miles in 535 minutes or .990704 minute per mile. The next day ten or fifteen minutes more were knocked off by the West Coast line, and the end is not yet.

Some Special Tools in the Cincinnati Milling Machine Company's Shops.—I.

By John Randol.

PLANING FIXTURES.

An examination of the various feed actions contained in the knee of the Cincinnati "Universal" leads at once to a desire to see the tools and fixtures by use of which this quite large piece can be, and is, machined to so close an approach to perfection as it must be to assemble at all.

The first of these special tools in the order of their use is the planing fixture and gage, for determining both the dimensions and position of the knee cuts, shown in Figs. 1 and 2.

Common practice with what would be passed as good tools for planing a double dovetail knee would include accurate right-angle plates with some form of gage for determining the depth, width and angles of the dovetail, male or female. The first cut would be made on one flat surface of the knee, which would be used as the table spot for the second cut, made with one rough surface of the knee against the angle plate; the third cut would be more difficult, requiring an accurate vertical placing of the side line of the previously made dovetail, and would, of course, include the use of a male or female dovetail gage as before.

In the case of the "Cincinnati Universal," the double dovetail on the knee is female on the vertical face, to take the male dovetail of the pillar, and on top is male to enter the swivel base of the sliding table. The angle plates used have flat feet to stand on the planer table, and accurately vertical dovetails solid on the angle plates to take whichever dovetail of the partly finished work is required to form the holding "spot," while the remaining dovetail of the knee is being planed; this leaves no possible chance for error. The exact procedure is as follows: The female dovetail of the knee is first planed, the knee being held by the rough male dovetail which enters a much too large female dovetail in the upright of the planer fixture, and is then adjusted to correct position by the use of set screws tapped through the walls of this female dovetail in the angle plate. This angle plate has permanently fixed to its top surface a cast-iron block; this cast-iron block is accurately finished to precisely the finished cut of the female dovetail to be produced, and thus forms a fixed gage so located at the top of the planing fixture that the end of the knee in process of being planed stands very close to it when the other dovetail is held by the set screws as described, so that it is easily seen when the set screws bring the rough casting into proper place for planing. The female dovetail is roughed out and the finishing tool is set against a thickness of tissue paper placed between the tool point and the gage surface of the fixed gage bolted to the top of the angle plate. This one thickness of tissue paper leaves enough metal for scraping to a perfect fit. After planing the female dovetail the gib screws are put in, and the knee is turned over on the second fixture, Fig. 2, and a rough cut is taken off the male dovetail face. The next operation on the knee is the scraping of the female dovetail to fit the pillar; the piece is then returned to the planer, and is put on the second angle plate again, having an exact duplicate of the pillar male dovetail on its vertical surface, to which the knee is secured by its own gib screws, precisely as it is finally to be held on the pillar. This second angle plate is used with an end support, *D*, Fig. 2, and at the top of the end support *D*, an accurately finished planing gage is formed representing the section of the male dovetail to be produced, and the tissue paper is again used for setting the finish cut tools.

By this simple means, bar dirt, an absolute certainty of perfectly placed planing is secured; the subsequent hand fitting by scraping, of course, may throw the parts part of a tissue paper thickness out of their correct relative position with each other, but any trifling error of such sort is rendered of no final importance by the method of boring the spindle seats, which brings the spindle with the knee infallibly.

These two dovetail angle plates and their respective gages are quite clearly shown in Figs. 1 and 2. They have previously had a brief mention on page 11 of the Machinist of May 21, 1891. The points of difference from common practice are in the dovetails on their uprights, and the fixed gages, which not only gage the dimensions and angles of the cuts, but also insure the relative position of the cuts with regard to each other. This is a combination which may be old to some of the readers of the Machinist, but is new to at least one of the contributors to that periodical. The very great advantages of a fixture which carries the gage for the cut to be made on or in the work held by that fixture, and carries that gage in correct position, so that it can be used for tool setting, is obvious; the tool which is to make the finish cut is set right before the cut is made, and thus the correct location of the cut is assured before the tool touches the work, and in place of many trials and anxious guesses, the workman can boldly run his roughing cuts up to the capacity of the machine, or up to a small finishing cut, with absolute certainty that he knows exactly what he is about. This can never be the case with a loose gage held in the hand as is the usual practice. This idea is available for almost all work which can be or need be gaged at all; it is difficult to imagine a case to which the "fixed-gage" idea is not applicable, and the conception of this happy thought is most creditable to Mr. Fred. Holz, designer of the "Cincinnati Universal," and most of the tools and fixtures here described.

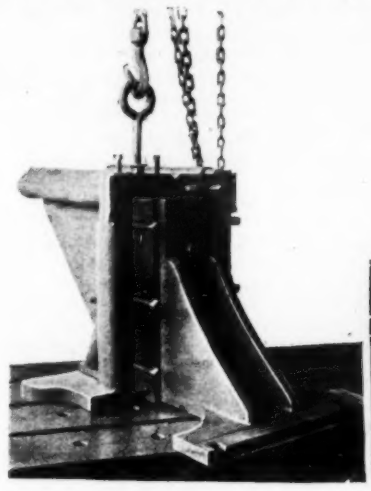


Fig. 1.

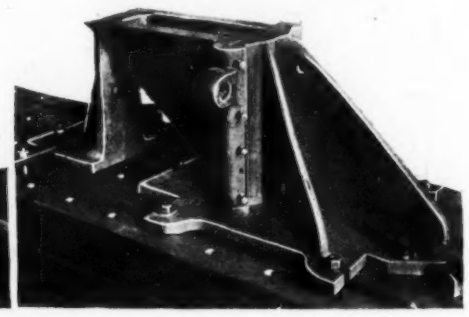


Fig. 2.

Fig. 3.

Fig. 4.

A SCRAPING STAND.

For the hand work of filing and scraping on pillar milling machine knees it is quite common to use special wooden "horses," shaped on top to hold the knee in suitable positions for operations on any of its many angled surfaces. The great convenience of the neat wide base column carrying a swivel top to which may be secured an arbor carrying any suitable vise or holding fixture on its end, will be appreciated at first sight by all visemen and fitters. Nothing is more common than to see a filer or scraper blocking up a piece to bring it suitably to his eye and hand; the light is as important as manual access, and both are with difficulty obtained at the same time, even under the most favorable of usual conditions.

With the "universal stand," shown in Figs. 3 and 4, all of the common difficulties of handling and placing dovetail pieces for filing and scraping disappear; any piece can be placed in any position desired by the fitter. Indeed the whole thing is of such obvious utility that on seeing it in use one instantly endeavors to remember where he has seen it used previously. This may be also an old device to some reader of the Machinist; it is original with the "Cincinnati Universal," and not in general use in New England shops. There is no doubt that the "universal stand" as shown in Figs. 3 and 4 is a very great convenience, and also a time saver; nor is there any doubt that it is a great aid to good work by putting every surface in the most favorable

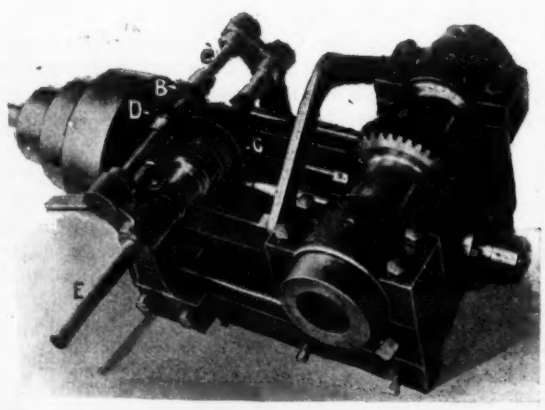


Fig. 6.

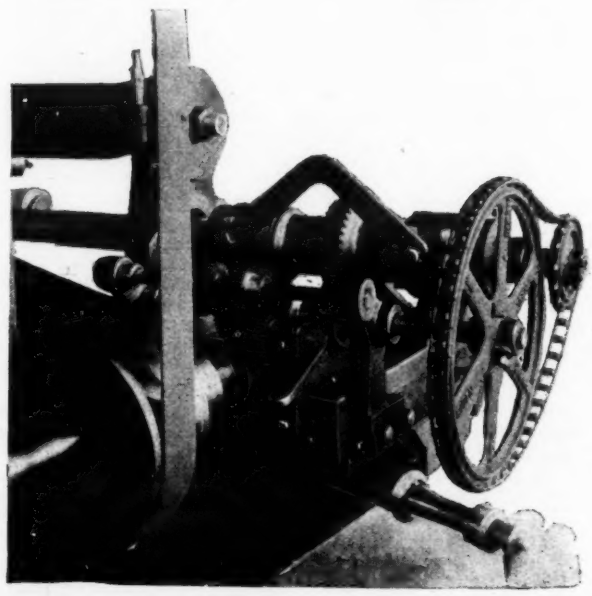


Fig. 7.

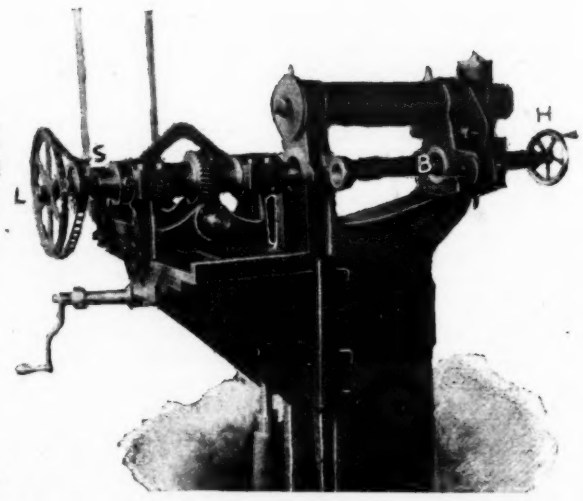


Fig. 8.

Special Tools.

light—a condition of the greatest importance for close-fitting operations.

The "universal fitting stand," as this inexpensive convenience might well be named, also greatly economizes floor and bench space; by its use more fitters can work comfortably on the same floor space than by the old method; the clumsy and dirty wooden "horses" can be put under the boiler, where their store of accumulated oil may be better used than by distributing it to everything touching or touched by the offensive and inadequate oil-soaked devices which the "universal fitting stand" replaces. Any shop which includes regular jobs of fitting of almost any description of small pieces will find this new floor tool a very great advantage. It is not patented. It is to be understood that none of the special tools described in this article are sold by the "Universal" Company.

This idea of the "universal stand" is carried out in drill-press fixtures for drilling oil holes in the knee and other parts, and is in all cases a very great convenience, a time saver and drill saver.

A SPECIAL BORING MACHINE.

Having thus provided for the possibility of good planing and fitting by giving the planer and viseman perfect holding and gaging tools, the next operations are the boring processes needed in finishing the frame, which are facilitated by a portable special head, shown by itself in Fig. 6, and at work in Figs. 7 and 8. The holes for the main spindle of the Cincinnati Universal form that especially trying combination which consists of two tapered holes of differing sizes, which are required to be precisely in line with each other, and also at precisely right angles to a previously finished surface. This job of two tapered holes, or one straight and one taper hole, to be bored precisely in line with each other, has always been considered very difficult to produce, and really is difficult with ordinary tools.

The portable boring head mentioned, at once removes all difficulty by providing a boring bar having two cutter blocks sliding on ways inclined to the boring bar axis, and moved by feed screws which slide either block either way at will at suitable rates of speed. The boring-bar drive is a three-stepped cone driving a worm shaft, horizontal, and located lengthwise of the table. This worm drives a worm gear on the boring-bar sleeve, carried in substantial uprights on the sliding dovetailed top member of the boring fixture, as shown clearly in Fig. 6. This top member slides on a dovetail on the sole plate, which is again, in turn, fitted with a female dovetail on the bottom by means of which the whole of this portable boring head is secured to the knee of the machine to be bored. It will be noticed that the right hand underneath dovetail jaw is tongued and screwed on the under side of the sole plate adjustably, so as to fit differing widths of knee dovetails. The chevron shaped bail, so conspicuous in the engravings, serves merely to take the chain hoist hook. The boring bar is the same in general construction as shown in Landro's Wheelock cylinder boring tools, AMERICAN MACHINIST, issue of May 2d. Fig. 7 is a rear view of the portable boring head at work, and Fig. 8 is from the same, propped up to give a general construction view. The front boring block is fed by a plain screw in the center of this boring bar, and this feed screw is driven by the small sprocket wheel *S*, from the large sprocket wheel *L*, Figs. 7 and 8. Obviously, if this screw has more turns than the boring bar itself, the boring tool carrying block will be fed in one direction; if less turns, in the other direction; and the greater the difference between the velocities of the bar and screw, the greater the feed of the tool blocks in one direction or the other. The boring head sleeve, which is solid with the worm gear, takes all the bars needed to bore the machine for the spindle seats, the overhead supporting bar, and back gear seats. The boring feed-screw drive is had through a fine worm on the sleeve worm shaft near the driving end; this drives the fine tooth worm gear *G*, Fig. 6, which has, fast to it, the spline gear *A*, which drives the pinion *B* fast on the shaft *C*; splined to *C* is the pinion *D*, which can drive the sprocket shaft *E* directly, or through a reversing intermediate gear *F*, while the clutch (plainly shown) either connects or disconnects the driving mechanism and sprocket shaft at will. To bore the supporting or overhead arm seat, the whole knee is raised the correct distance above the spindle seat boring position. To bore the back gear shaft seat the boring head slides along on its own sole plate to fixed stops, changeable for different sizes.

In order to bore all sizes of machines readily, and bore the two tapering spindle seats at the same time, the same feed screw is not used for both the tapering seat boring blocks; the back spindle seat is bored with the tail screw and its hand wheel *H*, Fig. 8, it being easy for the hand to retard the wheel as needed. This boring head is good, and is in everyday use. It is worm driven, as is the case with so very many boring head drives, large and small, and both worm and worm gear are made of gray iron.

Armor Plates in Europe.

English makers of armor plates and other war material have been complaining for a long while past that they are not given enough encouragement to go to any expense in improving their methods of manufacture. If the Government requires any special material it has always appealed to the cheapest market, irrespective of any other consideration than that of price, and as the English maker has to carry out experiments on his own responsibility he is obliged to ask for higher prices than his foreign competitors. Consequently, in many cases he has been passed over, and valuable orders for steel shells have gone to France. Of course the natural question arises, how is it that the English maker has not been able to keep pace with his foreign rival? The answer is simple.

The French Government when it requires any special war material invites specimens from the home manufacturers who are relieved of any expense incidental to trials. The war authorities make an exhaustive series of experiments, and select the most suitable material, for which important orders are given out quite irrespective of any question of cost. The maker is thus able to lay down a plant for the execution of the contract, and when this is completed he is at liberty to quote very low prices for supplies of material to foreign countries.

From an economical point of view this buying in a cheap market may be all very well, but it is now being urged that in depending upon the French makers for war material the country is placed in a somewhat precarious position. It is a fact at the present moment that there are no adequate means for the manufacture of shells for some of the largest marine guns, and in the event of war breaking out they would be practically useless. This difficulty will no doubt soon be remedied.

The War Department has been attacked so unmercifully for its selfish policy that it is hardly likely to give out any more orders abroad. English makers are determined to do their best to equip themselves with enough efficient plant to meet the home requirements, and at the present moment Messrs. Beardmore, of the Parkhead Forge, Glasgow, are laying down some powerful machinery for this purpose. They have lately succeeded in rolling armor plates under license from the Harvey Armor Plate Co., weighing 24 tons, and they will soon be in position to compete with the three Sheffield firms who have hitherto enjoyed a monopoly of this manufacture. At the same time there is little hope of English makers doing much beyond what may be required by the Government. Now that every European country is beginning to produce its own armor plates and shells, and are becoming more and more independent of foreign aid, the scope for further activity in this branch of trade is very restricted. The latest enterprise in armor-plate rolling is about to be carried out in Russia, where a Belgian company with a capital of $600,000, of which one-half has already been subscribed, purposes to lay down an extensive plant in the neighborhood of the Black Forest. As all the Russian armor plates have hitherto been supplied in England and Germany this threatens a serious falling off in the number of foreign contracts. The only opening for an important business is the probability of an increase of the floating armaments of the East, but even here Japan is establishing iron works for the supply of its own necessities, and should any contracts be given out abroad the American firms are in as good, if not better, position to secure them.

The Official Speed Trial of the "St. Louis."

The American Line steamer "St. Louis," on August 10th, had her speed trial to prove her qualification for carrying the United States mails under the contract conditions. Running with the tide and with a flying start over a course of 52 knots, she maintained an average speed of 23.6 knots, or 27.14 land miles, per hour; then making a long turn without reducing speed, she returned over the course against the tide and averaged 21 knots, or 24 land miles, per hour. The coal used was the ordinary coal of her regular voyages, and the fire rooms showed one-half inch of water pressure, or almost a natural draught. The engines made 95 revolutions per minute. The machinery was in perfect order and exhibited no signs of heating.

Thus the "St. Louis" has made the finest measured record. That she had previously not exceeded 19.8 knots was easily accounted for by the foul condition of her bottom, as revealed in the dry dock. It was found that her hull was covered with grass a foot long. It is expected that the corrected record will be 22.5 knots per hour. A speed of 20 knots would have secured the contract which the "St. Louis" now holds for ten years' mail service at $4 per mile, which means about $2,000 per day when running. We may reasonably expect that when, next year, she has more portly smoke stacks she will show a much better average running than she has yet reached, and then we may expect to see her beaten by a still later born American ship.

Electric Power for San Francisco.

Seventy-five miles north of San Francisco there is situated, at an elevation of 1,317 feet above the sea, a body of water known as Clear Lake. It has its outlet in Cache Creek, a stream supplying about 327,000,000 gallons of water daily. The plan of a newly formed company is to construct a big dam on the creek some five miles below the lake outlet. From this reservoir the water will be carried in large pipes along the stream to a point known as Wilson's farm, where a power plant will be established. In traversing this distance the water will have a fall of 454 feet. It is estimated that three lines of pipe will develop 28,950 horse-power at the dynamos, 72 per cent. of which, by electrical transmission, would deliver 20,845 horse-power to the motors in San Francisco. The water will be shot through Pelton wheels which will be connected directly with the dynamos. The latter will be among the largest and most powerful in the United States. The electricity will be transmitted in a direct overhead line on large bare copper wires to San Francisco and the adjacent cities. The transmission of the electricity under the waters of the bay is a most difficult and costly problem, but it is thought that recent inventions have made this possible without too much loss of power.

A Proposed Wage Scale.

An interesting contribution to the solution of the wage-adjustment problem is found in the proposition of the Weavers Union of Fall River, Mass. We get our information through the *Industrial Record*. It is believed that a scale may be based upon the margin between the cost of raw material and the value of the product, or, say, between the cost of 8 pounds of cotton and the selling price of 46 yards of cotton cloth. In 1893 this margin was 60.3 cents, and 21 cents per cut were paid. This was the first reduction. In 1894 a second reduction was made. The margin then was 61.85, and 18 cents were paid. Outsiders, of course, are tempted to ask, what justified this reduction. Later the wages seem to have been still further reduced to 16 cents. In April of this year a partial restoration was made. The margin was 69½ cents, and the price was raised from 16 to 18 cents. To-day the margin is 76 cents, and 18 cents is still the price. If an agreement can be made in January and July of each year for the ensuing six months, fixing the price per cut at, say, one-quarter of the margin, it would seem to be to the interest of all parties to effect it. The manufacturers are said to favor the idea, as it would be a great advantage to them to be sure of their expenses for six months at a time. They would then be safer than at present in making contracts.

Under the ownership of the Siemens & Halske Co., the Grant Locomotive Works, at Chicago, are reviving, and the first locomotive under the new management was completed recently. The engine was built for the C., B. & Q. R. R., from the road's plans and specifications, and is a 10-wheeler with 19″x24″ cylinders, 62-inch drivers, carries steam at 150 pounds, and weighs in service 192,000 pounds.

Rapidity of production is the supreme characteristic of machinery, and perhaps in nothing is this more strikingly exhibited than in the making of history by machinery. It seems almost incredible that only this month the son of Eli Whitney, the inventor of the cotton gin, has died, having attained little more than the allotted threescore and ten.

Gus. C. Henning, M. E., sails to-day on the "Columbia" for Zurich, to attend the conference on unification of methods of testing. Mr. Henning will officially represent the American Society of Mechanical Engineers.

At the Norton can factory, at Whitestone, L. I., six boys are said to have had fingers smashed or cut off in presses during a period of two weeks.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9″ × 12″, 6″ × 9″ and 4½″ × 6″. We recommend the 6″ × 9″ size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

We have received the catalog of the Chicago Skein and Axle Co., Grand Crossing, Ill. This is devoted to the illustration and description of steel skeins for wagons, tire bending machines, drill presses and other machines for blacksmiths' use. It is 9⅜″x6¼″.

The Waltham Watch Tool Co., Springfield, Mass., send us their catalog of machine and other tools, especially adapted to watch toolmakers and others who have fine work to do. It illustrates and describes the Van Norman bench lathe with milling attachment and similar tools of this class. It is 7¾″x4⅝″.

Norman W. Henley & Co., 132 Nassau street, New York, issue a list of books specially adapted to the needs of machinists, engineers, electricians and mechanics generally. It includes a full description of their latest book, "The Modern Machinist," with a number of specimen engravings taken from its pages. It is sent by mail free to any address upon application.

We have received the catalog of the Lane Foundry and Machine Works, Huntingdon, Pa., in which are illustrated and described various forms of engines, including the Lane automatic vertical and throttling engines, vertical engines with boilers, vertical portable engines, horizontal engines, center crank, portable, horizontal engines and horizontal tubular boilers. The catalog gives particulars of sizes, prices and telegraph code, etc., and is 4″x6¾″.

The Bullard Machine Tool Co., Bridgeport, Conn., send us an exceptionally finely gotten up catalog, which is mainly devoted to the illustration and

description of boring and turning mills, though there are also some illustrations of ordinary engine and turret head lathes. It is 6⅞"x10⅜", and could readily be trimmed to standard size (6"x9"), so that it would go in a standard filing cabinet, and is well worth the trouble of doing it; though such trimming would mar it somewhat from an artistic point of view.

We have received from the Maxim Nordenfelt Guns and Ammunition Co. (Limited), 32 Victoria street, London, S. W., England, a publication devoted to the description of the work of the Maxim Automatic Gun in the Matabele and Chitral Campaigns in 1893-4 and 1895. There are numerous extracts from the English press giving an account of the result of the fire of these guns in the campaigns mentioned, and there are numerous fine illustrations of various types of the guns adapted to a variety of service. The pamphlet is sold at one shilling, and is 6"x9¾".

W. D. Forbes & Co., 1300 Hudson street, Hoboken, N. J., have issued an illustrated descriptive catalog which is devoted to their high-speed automatic engine, yacht engine, milling machine, revolution counters, hydraulic hand pumps, etc. In this catalog they explain their methods of handling special work, which forms a large proportion of their business, and set forth some of the most common causes of misunderstanding regarding such work. This part of the catalog is especially well worth reading by those who have to do with the construction of special machinery. The catalog is sent to those interested and is standard size, 6"x9".

MANUFACTURES.

The H. C. McDaniel Lumber Co. has been organized by John J. Ganahl and others at St. Louis, Mo.

The Phleiger Lumber Co., of Caruthersville, Mo., has recently been formed by T. L. Taylor and others.

The Riverside Tube Works, of Benwood, W. Va., has increased the salary of their employes 10 per cent.

The Lone Star Lumber Co has recently been organized at Texarkana, Texas, with J. M. McGill as president.

The Lester Automatic Faucet Co., of Atlanta, Ga., has been formed with a capital of $50,000. A. G. Rhodes is president.

The Noblestown Mfg. Co., of Noblestown, Allegheny County, Pa., has recently been organized with $30,000 capital.

A second advance of 10 per cent. has recently been made to the employes of the Norton Iron Works at Ashland, Ky.

The Co-operative Cotton Mills Co., of Meridian, Miss., has been formed by J. T. Chalk and others with a capital of $500,000.

The Stanley Cycle Mfg. Co. has been organized by Leo Schlesinger and Leopold Stern at New York City with a capital of $100,000.

The Blumer & Doscher Manufacturing Co., of New York City, has been organized to manufacture cutting and corrugating tools and machines with a capital of $10,000 by James Blumer and Frederick H. Weinhauer, of Brooklyn, N. Y.

Unusual activity is seen in all departments of the Link-Belt Machinery Co., Chicago, they having more contracts on hand now than at any similar period during the past five years. Recent orders for the "Standard" water-tube safety boilers have been received from the following: Western Electric Co., Chicago, 600 horse-power; Globe Soap Co., Cincinnati, 250 horse-power; Mabley & Co. Bldg., Detroit, 700 horse-power; Jobbins & Van Ruymbeke, Aurora, 150 horse-power; Keystone Woven Wire Fence Co., Peoria, Ill., 75 horse-power; Cincinnati Edison Co., Cincinnati, 500 horse-power.

Machinists' Supplies and Iron.

New York, August 24, 1895.

Iron—American Pig—We quote standard Northern brands, $14 for No. 1; $13 for No. 2; $12.75 for No. 2 Plain; and $12.50 for Gray Forge. Southern brands, $13.50 to $14 for No. 1; $13 to $13.25 for No. 2; $12.50 to $12.75 for No. 3; $13 to $13.25 for No. 1 soft; $12.75 to $13 for No. 2 soft; and Foundry No. 4, $12.25 to $12.50.

Antimony—Prices are steady and dealings small. We quote Cookson's, 8c.; Hallett's, 7¾c. to 7¾c.; Japanese, 7c.

Lard Oil—Prime City, 50c. to 51c.

Copper—Lake, 12¼c.; Electrolytic, 11⅞c. to 12c, Casting, 11¼c. to 11¾c.

Lead—Dealings moderate and prices somewhat lower, ranging about 3.50c. to 3.52½c. for round lots and 3.52½c. to 3.55c. for car loads.

Spelter—There is little change in prices; 4.20c. to 4.25c. is quoted.

Tin—Since our last, prices have fallen and risen again to a slightly higher level, 14.20c. being now quoted.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS.

On and after July 4th this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Wanted—Bright, active machinists to canvass for subscription to American Machinist, liberal commission. Address, with refs., Subscription Dep't, American Machinist, 203 Broadway, N. Y

First-class, reliable engineer and draftsman wants to change pos'n. X, Box 85, Am. Machinist.

Mechanical draftsman, 29 years old, good practical experience, wants position. A. H. G., Am. Mach.

Wanted—Situation as general foreman or superintendent of high speed engine shop; at present supt. of shop. "D. A.," care Am. Machinist.

Practical machine man with some money to take charge of foundry and machine works. Address D., care American Machinist.

Wanted—Position by an all round machinist as foreman of small manufacturing or job. shop. Address for particulars Box 91, American Machinist.

Wanted—Men to sell new boiler-tube cleaner. Walker & Co., 287 Fourth Avenue, New York City.

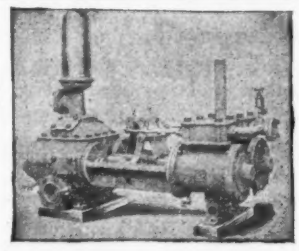
Mechanical draftsman with technical education, shop and office experience, wants position. Address Box 68, American Machinist.

Wanted—Mech draftsmen in Northern, Western, Southern States, hav'g evenings free; state pres. pos. Edwin Guthrie, Corcoran Bldg., Washington, D. C.

Foreman Blacksmith Wanted—Man familiar with engine and ship work. Apply by letter, stating experience and age, to The Atlantic Works, East Boston, Mass.

Experienced Designer Wanted—Familiar with all classes of bookbinders' and paper-cutting machinery, for the West. Address, stating all particulars, "A," care of American Machinist.

(*Continued on Page* 693.)



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SEND FOR CATALOGUE E.

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1895 Gear Book, Free.
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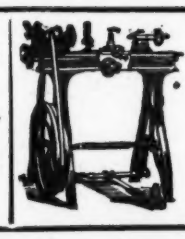
Lexington, Mass., and 125 South 11th St., Philadelphia, Pa., and 86 Seneca St., Cleveland Ohio.



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ARE SUPERIOR TO LATHES FOR FACE PLATE WORK.
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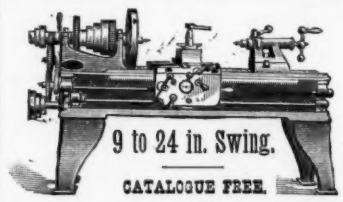

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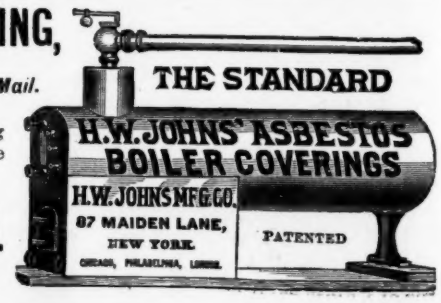
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.
87 Maiden Lane, NEW YORK.



Mechanical engineer, graduate and experienced draftsman, would like pos. as inspector, assistant sup't or draftsman in machine shop (steam engine or spec'l mach'y), Chicago pref'd. Box 88, Am. Mach.

Wanted—M. E., age 28, tech. education, experience in designing, drafting and handling machinery, wants position at small salary with chance for promotion; heavy work preferred. Address Box 89, American Machinist.

Draftsman, 27 years' old, 11 years' experience, 5 years' designing and originating automatic machinery, 3 years as chief draftsman working from 6 to 10 men, would like to change position. M. E. D., care American Machinist.

Millwright, toolmaker, 35, recently owned small shop, experienced setting up machinery, shafting, repairs to lathes, planers, milling machinery, etc., making of small cutters, shell reamers, power hammer dies, etc, wants position. Vic., Am. Mach.

Wanted—By an Eastern machinery house selling largely engines, boilers, shafting and machinery, a resident agent in the city of Montreal. Reply, stating age, experience and salary to
Box 86, American Machinist.

Wanted—Position as instructor in machine shop of some school or university teaching engineering; applicant has had 13 years' experience as machinist and 7 years as draftsman. W. S. Leonard, Battle Creek, Mich.

Mechanical engineer wishing to make a change within a few months desires situation as superintendent or manager; experienced on engines, boilers, hardware mfg., mining plants, etc.; accurate on estimates; up-to-date in practice. W., Am. Mach.

Wanted—Any firm wanting an engineer who can establish discipline and systematic methods producing lowest cost and best workmanship, as superintendent or manager can find a man with highest references and a record by addressing Experience, care American Machinist.

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Wanted—A position as traveling representative for machinery or tool builder; experience has been mainly in shops as toolmaker, etc., but think I can sell goods, and want a chance to start at the bottom and work up; 25 years old, strong, healthy, good address; reference as to character, habits, etc. Address G. J. F., American Machinist.

Wanted—A superintendent to take charge of a brass factory who is thoroughly experienced in the mixing of metals and finishing of valves, cocks, etc., for steam and water service; for a good man who knows his business and can handle men there is a good position. Address Box 87, American Machinist.

Advertiser has been otherwise engaged of late and would like to correspond with parties in need of a foreman or man to fill other responsible position, as I wish to secure position in such capacity on or before October 1st; can furnish first-class references as to ability, etc.; or correspondents can refer to columns of the "A.M." and other journals, and to my recently published book, "The Modern Machinist." Address John T. Usher, 498 Third Avenue, New York City.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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Wanted—Reliable manufacturer to place patent fine adjusting and transfer calipers on the market; description in Am. Machinist Aug. 15, 1895, page 644. Arthur Munch, 658 E. Fifth Street, St. Paul, Minn.

For sale—Machine shop well stocked with tools, with good specialties and large jobbing trade, capable of employing 25 hands; sickness the cause of selling. Address Box 92, American Machinist.

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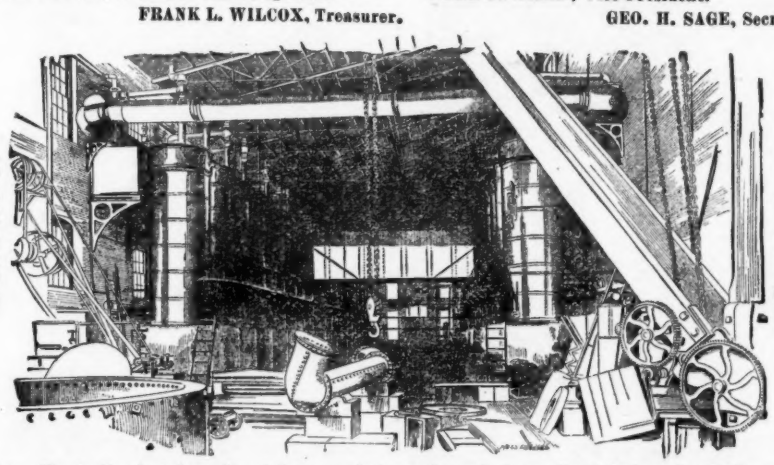

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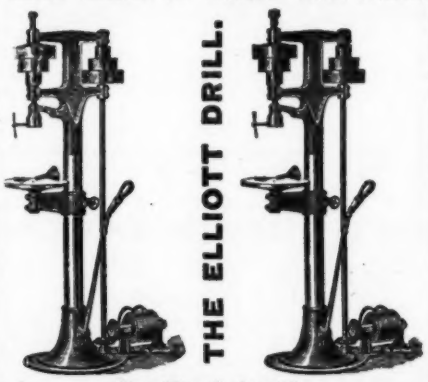

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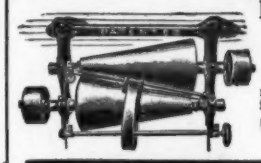

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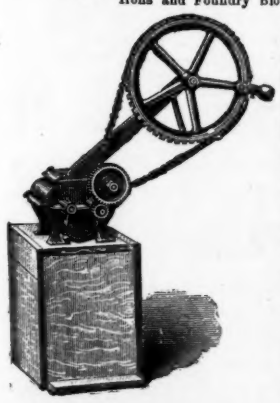

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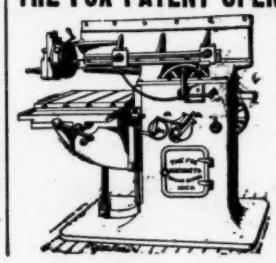

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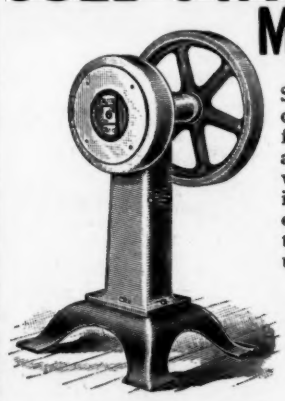

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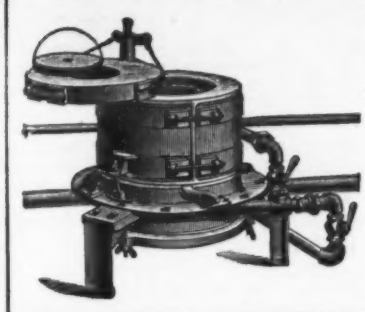

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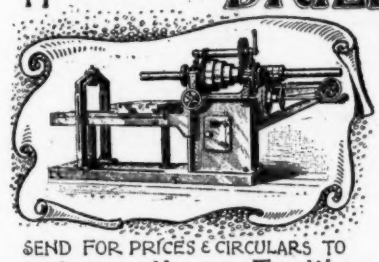

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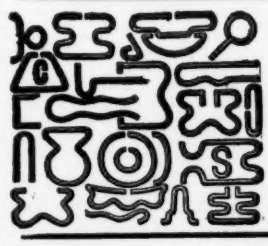

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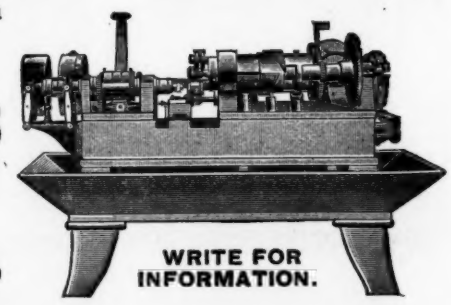

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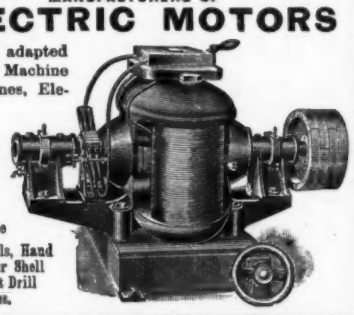

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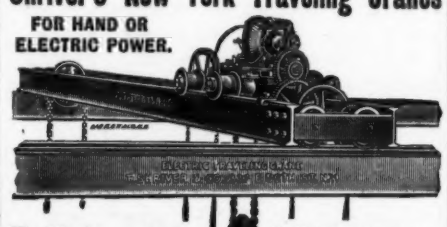

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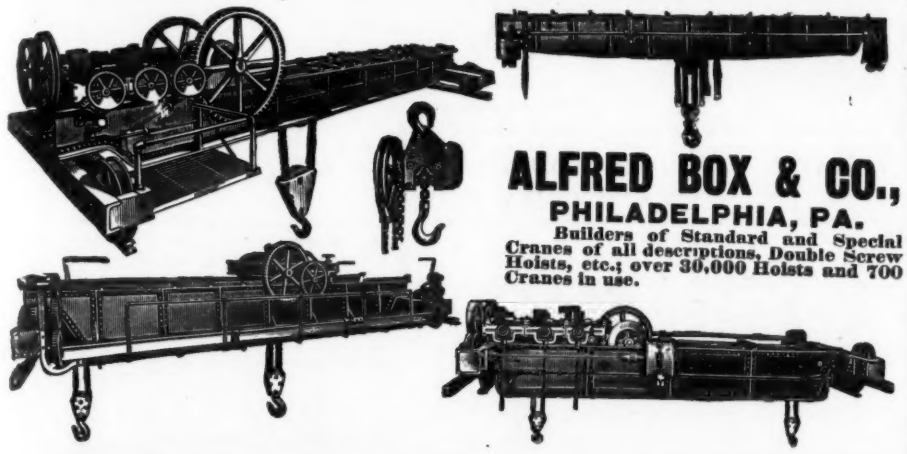

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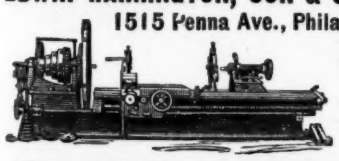

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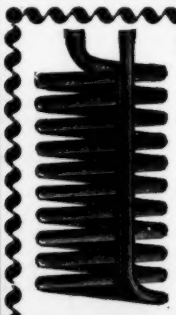

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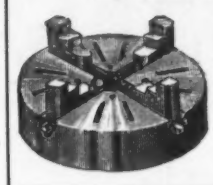

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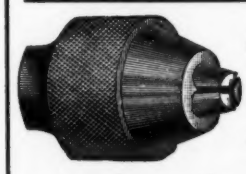

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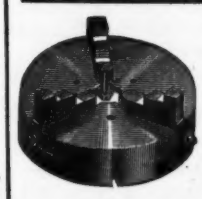

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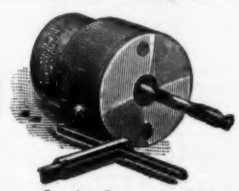

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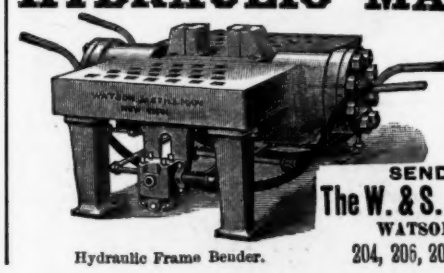

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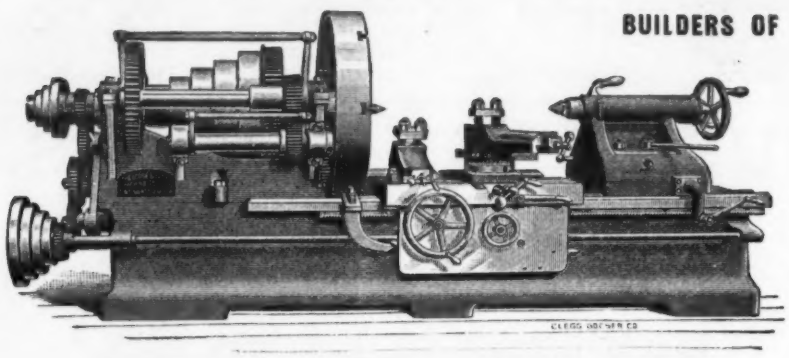

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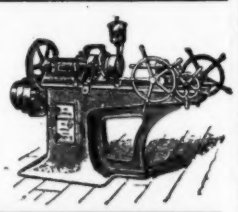

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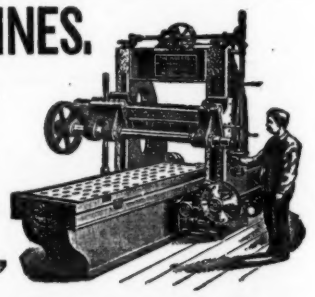

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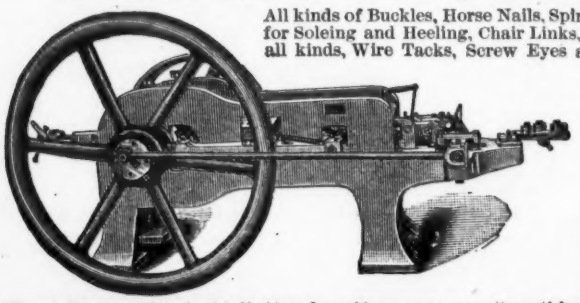

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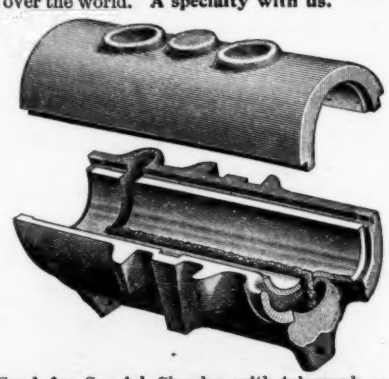

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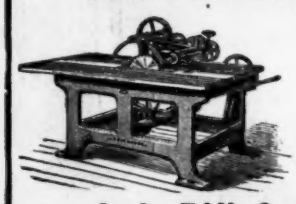

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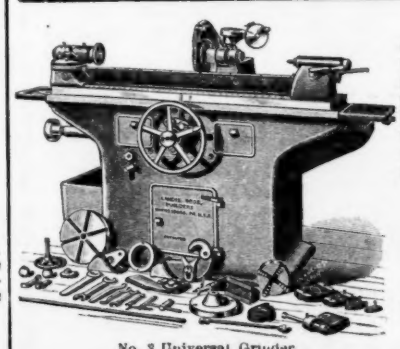

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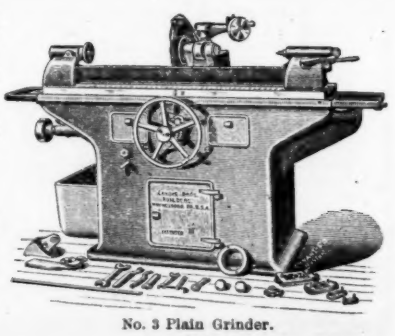

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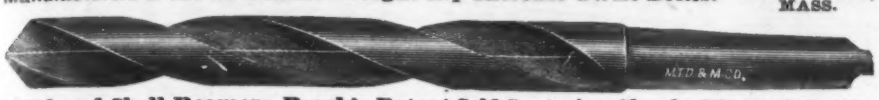

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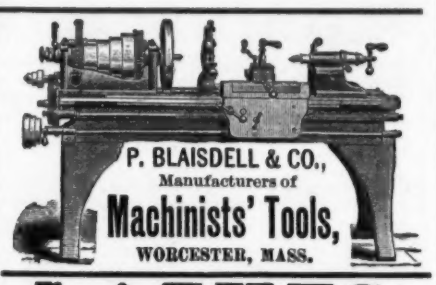

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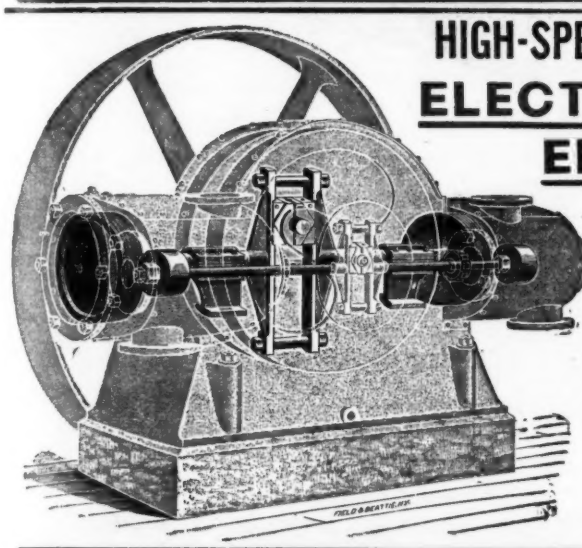

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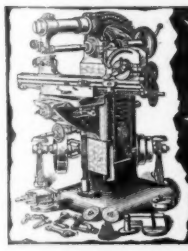

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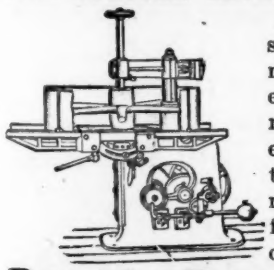

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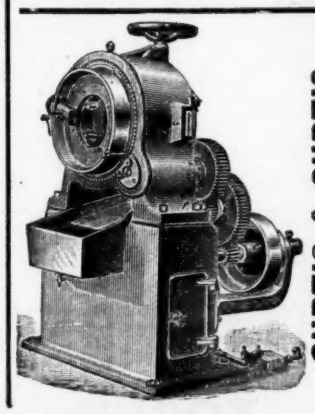

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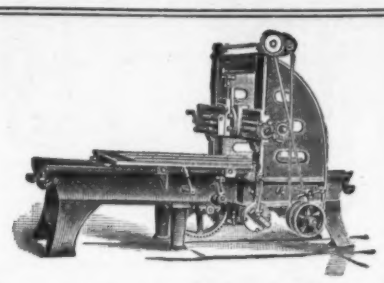

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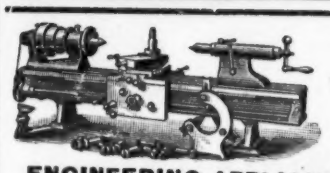

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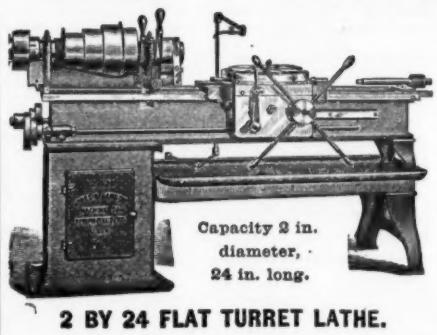

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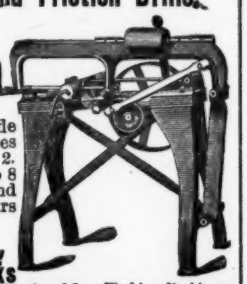

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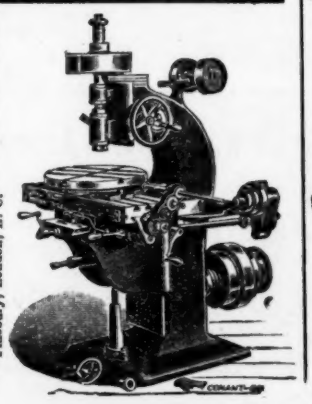

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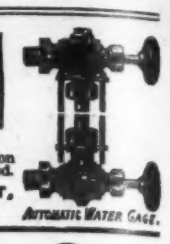

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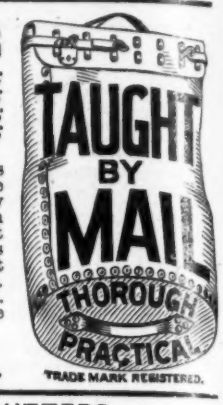

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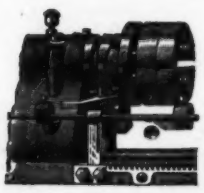

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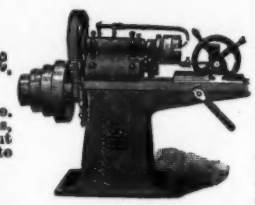

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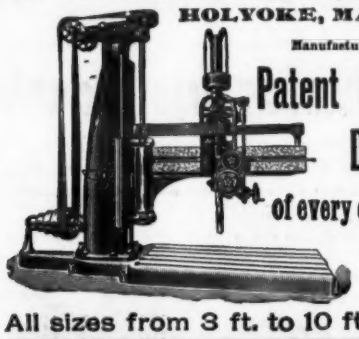

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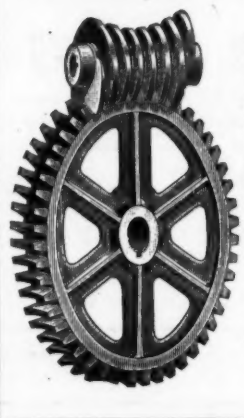

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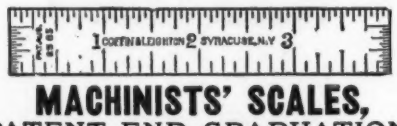

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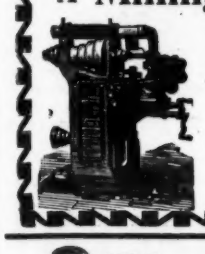

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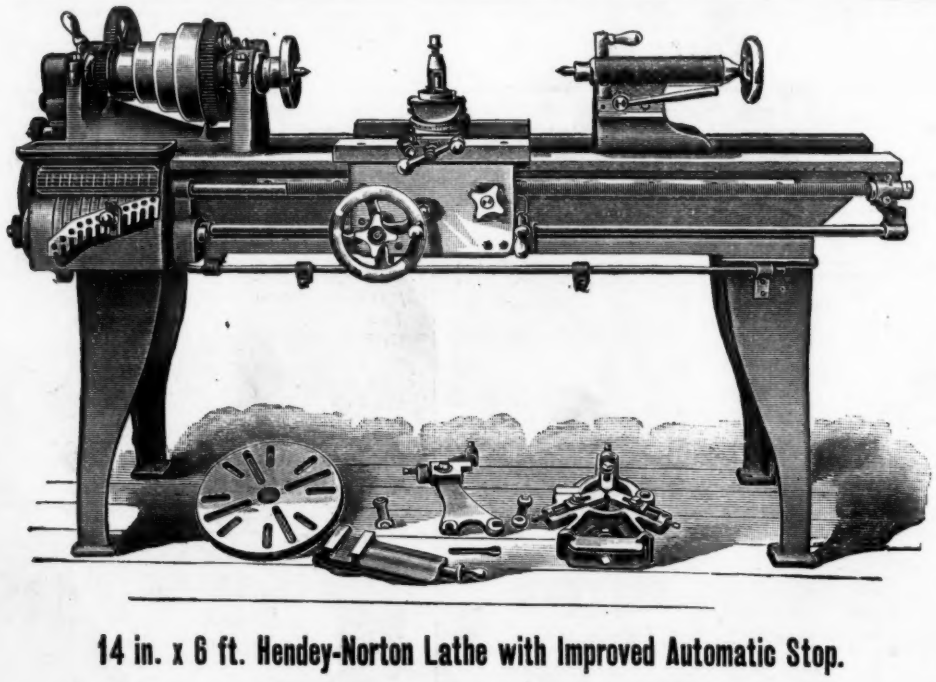

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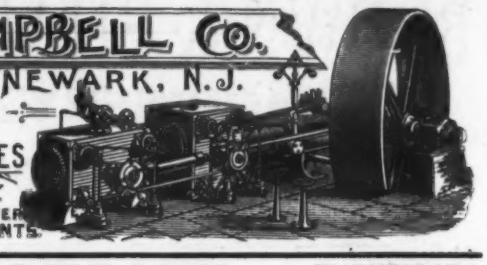

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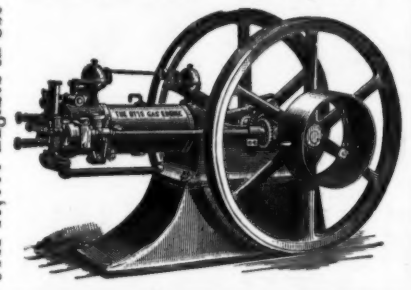

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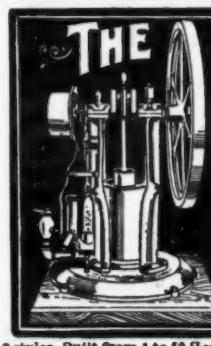

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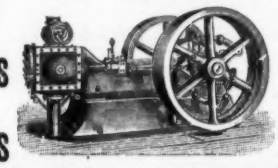

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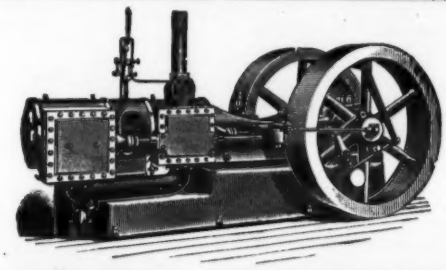

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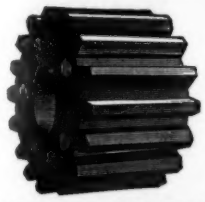

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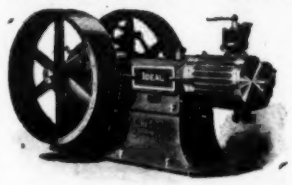

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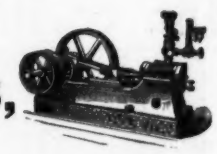

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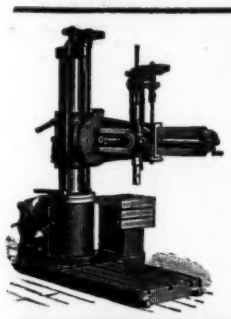

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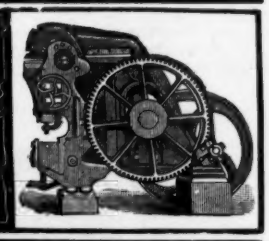
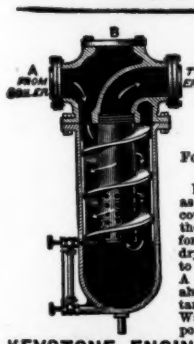


DRY STEAM.



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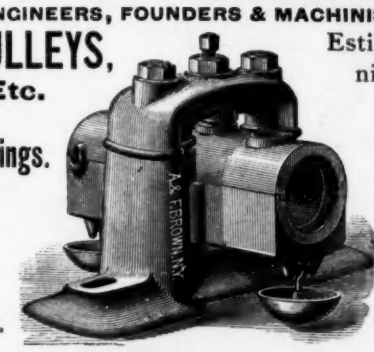

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Also for Erecting same.

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1,000 MEN: FULL TIME.

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Our vacation is not only a benefit to our men, it is an advantage to our customers, as it materially assists us in keeping our plant in the condition requisite for maintaining the character of our work.

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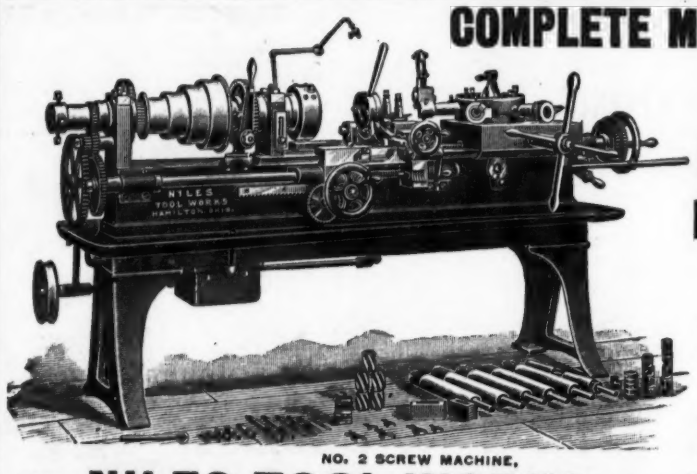

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THE ORIGINAL UNVULCANIZED PACKING.

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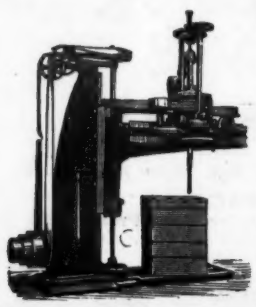
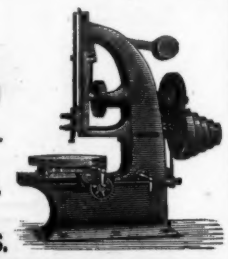
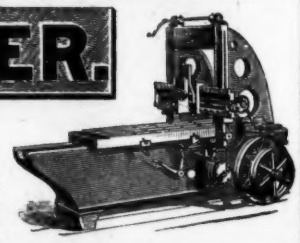




THE GRAY PLANER.



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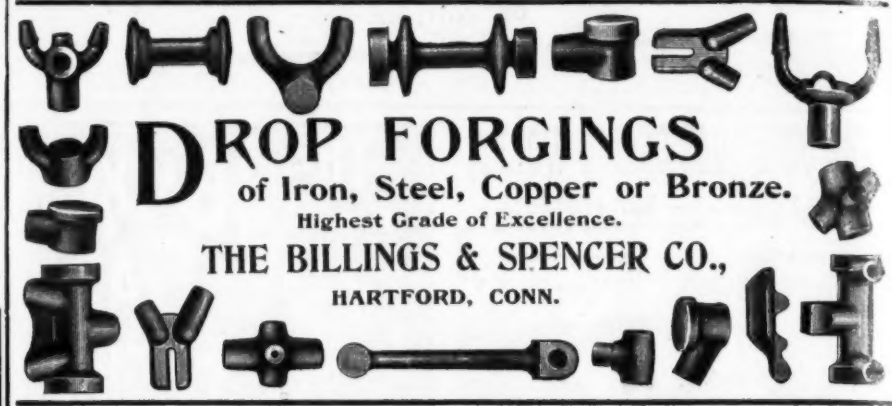

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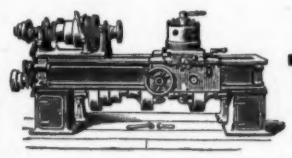

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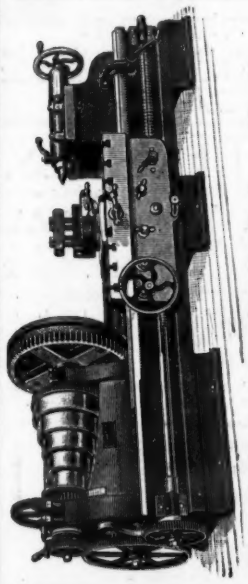

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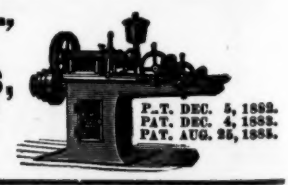

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